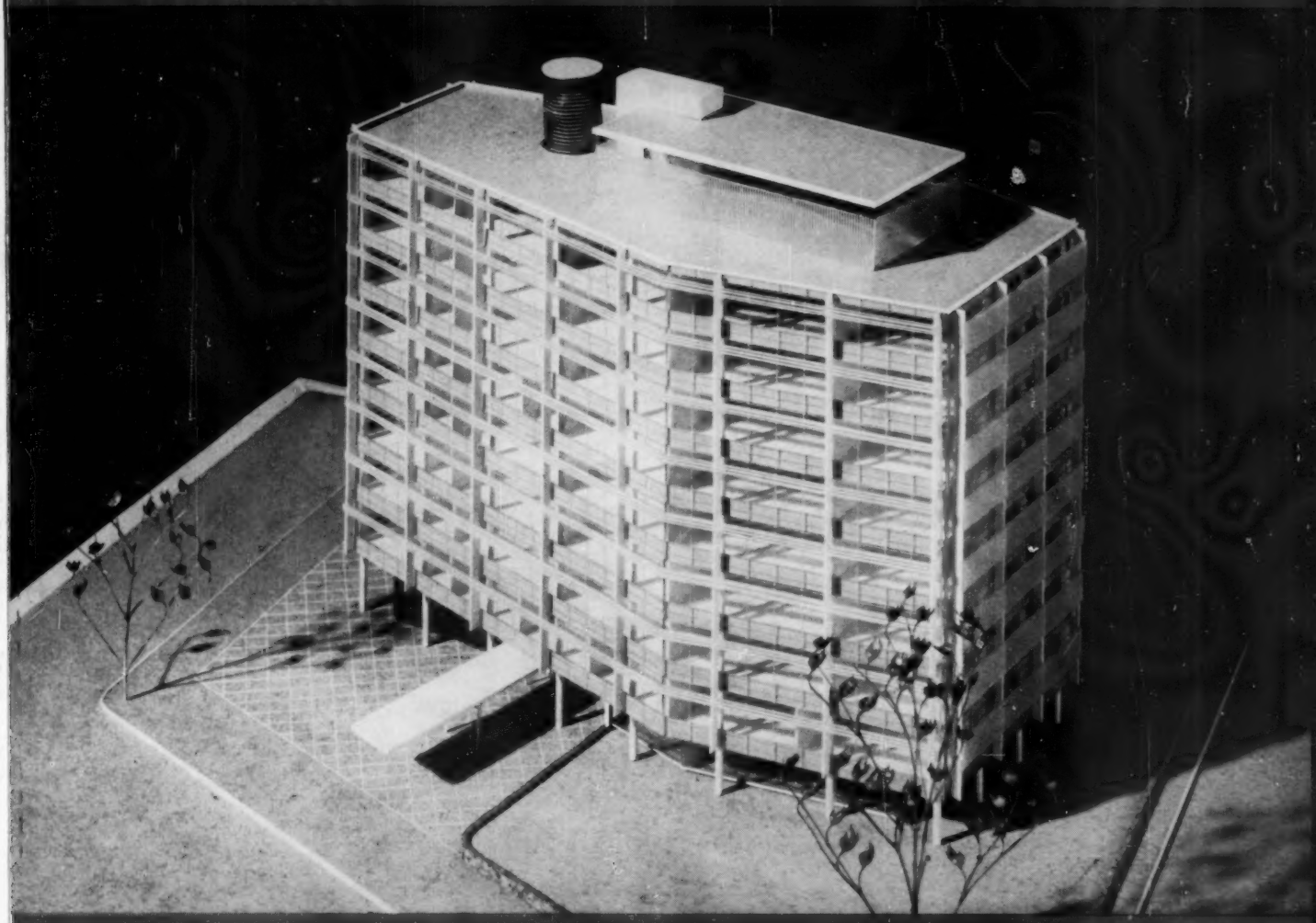
NOVEMBER 1952

THE SCIENCE TEACHER



- The Need for Scientific Talent
- The Elementary Teacher's Task
- Inductive Approach to General Science
- Demonstration of Valves of the Heart
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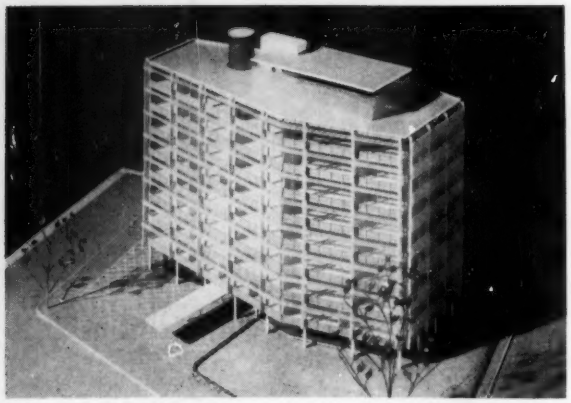

THIS MONTH'S COVER . . . shows the eight-story headquarters building proposed for the American Association for the Advancement of Science in Washington, D. C. Designed by the Architects Collaborative, the building will have supporting columns exposed on the first floor and visible through the glass walls as they rise to the roof. Site of the building faces Scott Circle, N. W., along Massachusetts Avenue between Fifteenth and Sixteenth Streets; it is only one block from the National Education Association which houses the headquarters offices of NSTA. For additional information, see the story on page 287. ***Photo by Robert D. Harvey Studio.***

Guided Missives

I am extremely happy to hear that my project in the 1952 program of Science Achievement Awards for Students has been selected for a First Place Award. I want to express my thanks for the award and for the opportunity of being a part of such a worthwhile program. Also I want to say that much of the credit for my project and my participation in your program goes to Mr. Howard Owens, science teacher at Northwestern High School.

DON R. BOYLE
Hyattsville, Maryland

. . . Thank you for your card and for the services to which NSTA membership entitles one. May I also send best wishes to your Association and all American members and assure you of the gratitude which so many of us here in Britain feel towards your country, at this time when so much depends upon our two countries' cooperation.

REGINALD WHITEHOUSE
Newark, Notts, England

Thank you for the honor of selecting me for an Honorable Mention Award. I plan to become a research chemist and am now majoring in chemistry at the University of California at Los Angeles.

MARIO J. ANTOCI
Los Angeles, California

Thank you so much for your letter and for its good news. I am indeed delighted, and am grateful to the National Science Teachers Association and to the American Society for Metals. Kindly convey these expressions to both organizations. The award money will certainly encourage me to continue my studies. I am now at Rensselaer Polytechnic Institute, and I like it.

DAVID Y. SMITH
Troy, New York

. . . I wish to express especially my pleasure with the articles, "Experiments With an Electrical Network Board," in the February 1952 issue, and "Simple Apparatus for Demonstrating Chokes and Condensers," in the March 1952 issue. We assembled the equipment indicated in these articles and found it extremely valuable for instructing the principles involved.

ANDRE DURY
San Francisco, California

. . . If Herbert Zim's paper (published in the September issue of *TST*) is typical of the caliber of the Ann Arbor conference, I am sorry indeed that it was impossible for me to be there. One thing in this issue is embarrassing to me. In the quip on "Science Education in Civil Defense" (page 167) the italics after my name make it appear that I acted as chairman of the committee, while actually Stan Williamson served most efficiently in this capacity. I hope that a correction can be made in the next issue.

G. DAVIS CHASE
New Britain, Connecticut

. . . One aspect of Dr. Zim's article interested me profoundly. His discussion of the role of laboratory experiences seems to point up the crying need for problem-solving laboratory exercises as a replacement for the cookbook type now in general use. . . . Many schools, not held down by tight syllabus requirements or uniform state examinations, would be grateful for any information now available for problem-solving ideas in any of the science areas.

CARL FICHANDLER
Brooklyn, New York

Editor's note: Send your ideas along to Mr. Fichandler. Meanwhile, what would you think of an NSTA workshop that would lead to a publication on "The Problem-Solving Approach in Science Teaching"?

THE SCIENCE TEACHER

The Journal of the National Science Teachers Association, published by the Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. Membership dues, including publications and services, $4 regular; $6 sustaining; $2 student (of each, $1.50 is for Journal subscription). Single copies, 50¢. Published in February, March, April, September, October, and November. Editorial and Executive Offices, 1201 Sixteenth Street, N. W., Washington 6, D. C.

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REMINDER TO *TST* READERS AND SUBSCRIBERS

The publication schedule of *The Science Teacher* was moved up to begin with the September issue this fall. Therefore, this is the last issue of Volume XIX and of the current calendar year. The next issue will appear in February 1953.

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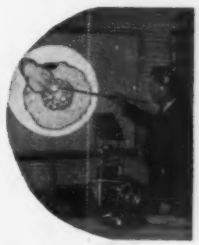

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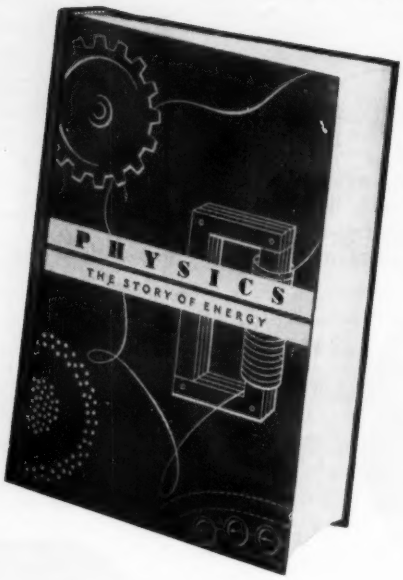

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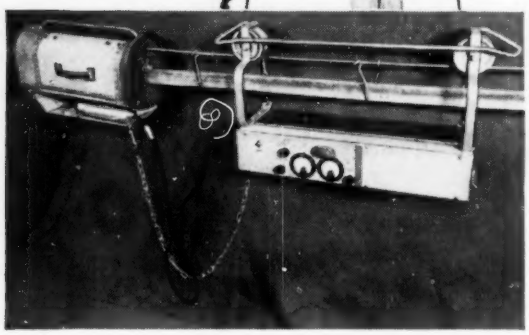

For test, the cable is cleared of protective nitrogen or air, and filled with Freon gas. Case at left collects escaping gas which operates Freon-sensitive detector underneath. At points where Freon escapes through sheath cracks, the box at right—a combined control unit and power supply—rings a bell. Workmen mark the point of leak for later repair.

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THE SCIENCE TEACHER

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The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

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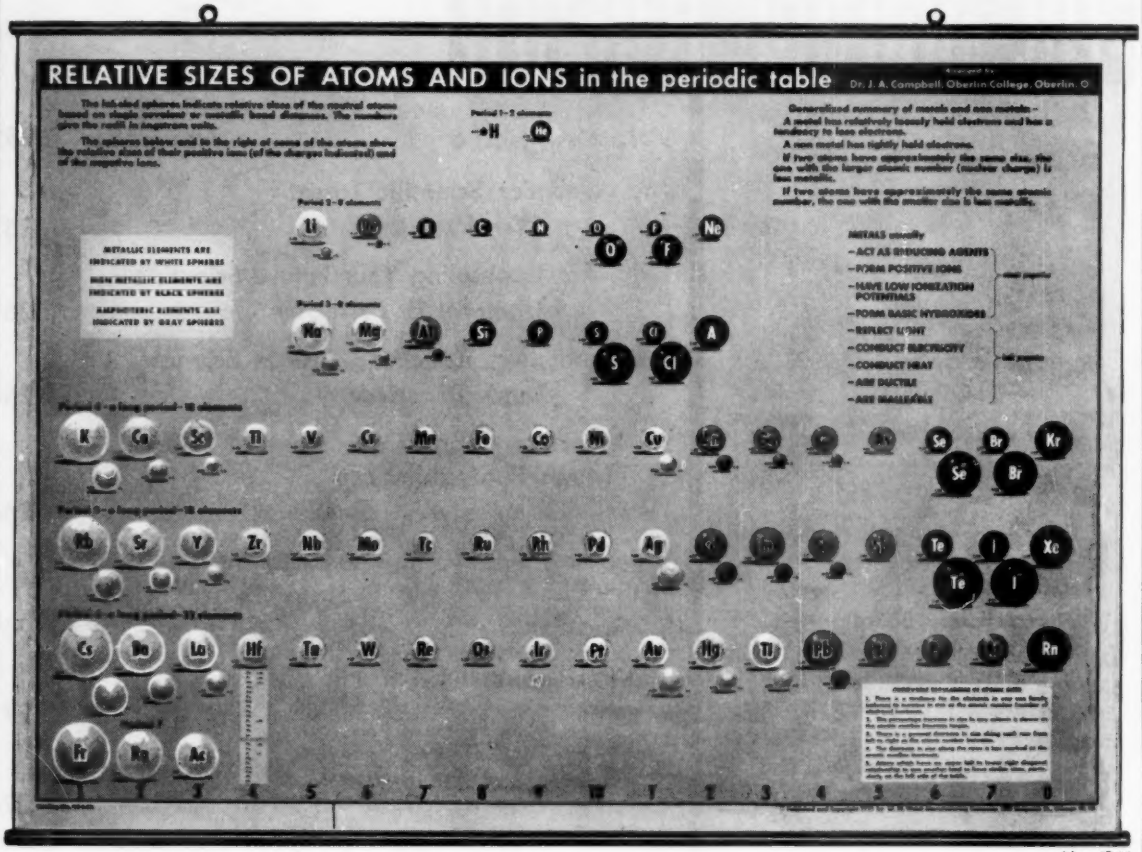
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THE NEED FOR SCIENTIFIC TALENT

By ALLEN V. ASTIN

I APPRECIATE this opportunity of talking before members of the National Science Teachers Association on the need for scientific and engineering talent. To those who are concerned with the planning and carrying out of scientific and technologic investigations this need is, and has been, so obvious that further discussion of it sometimes seems hardly necessary. The need, however, is so acute, its remedy so essential to the country's security and continued prosperity and the mechanism of remedy so slow and difficult to carry out that I don't believe the problem can be stressed too often or too much. The importance of science and technology to our present way of life and to its continued advancement should be well-known to all science teachers since the country draws on you to recruit and start the development of its future scientists. The key role played by the high school teacher in influencing young people in their selection of careers makes this audience a most appropriate one to have all possible information concerning the present and future needs for scientific and engineering talent.

I should like to discuss two aspects of this problem: first, the nature and extent of the shortage of engineers and scientists, and second, why the need for such professionally trained individuals is a continuing and expanding one and not just a transient flurry due to a temporary emergency. But before I do this, I would like to state briefly the interest of the National Bureau of Standards in this subject.

The National Bureau of Standards is a national physical science laboratory charged by the Congress with responsibility not only for the development, maintenance, and custody of the standards for physical measurement but also with responsibility for the determination of basic physical constants and properties of materials; with the testing of, and the development of methods of testing materials, mechanisms, and structures; with cooperation with other Government agencies and private organizations in the development of standard practices, codes, and specifications; with rendering scientific and technical advisory services to other Government agencies; and with the invention and development of devices to serve special needs of the Government. To fulfill these responsibilities the Bureau must keep abreast of and conduct active research programs in the many branches of physics, chemistry, metallurgy, mathematics, and engineering. This is a growing and ever-changing program which has to be adapted to an expanding science. The actual

ALLEN V. ASTIN, Director of the National Bureau of Standards, Washington, D. C. Dr. Astin's analysis of current scientific manpower problems and the outlook for the future, as abstracted somewhat in this article, was given as one of three principal addresses at the Southern Regional Conference of NSTA held in Atlanta, Georgia, October 16-18. His recognition of the long-range importance of high school science teaching in helping to alleviate the situation is indicated by his acceptance of membership on the Administrative Committee of the Future Scientists of America Foundation.

Born in Salt Lake City, Dr. Astin obtained his A. B. from the University of Utah and holds the M. S. and Ph. D. degrees from New York University. Dr. Astin became associated with the National Bureau of Standards in 1930 and was named its Director last year. His fields of research have included dielectric constants and power factors of liquids, electronic instruments and ordnance, proximity fuses, and guided missiles.

implementation of the program naturally requires a staff of competent and well-trained scientists and engineers, and the development and maintenance of this staff requires an alert and long-term policy toward recruitment. Our attempts to carry out this recruitment program have made us keenly aware of the present shortage. Also one phase of our long-term recruitment program involves summer training appointments for college students and in some outstanding instances for recent high school graduates. This program has brought us in close touch with many of the educational institutions throughout the country and with many of the plans to encourage young people to select a field of science for their life's career.

Evidence of the Current Need

One of the most striking and important indications of the acuteness of the current shortage and its importance to our national welfare is a recent policy statement of the Office of Defense Mobilization. This organization is charged with the direction, control, and coordination, on behalf of the President, of all mobilization activities of the Government, including production, procurement, manpower, stabilization, and transportation. This policy statement is (in part) as follows: "The importance of scientists and engineers in the establishment of the strongest possible defense and, should war come, in insuring ultimate victory is well established and widely recognized. Furthermore, there is no limit in principle to the advances which can be made in science and technology, practical limits being imposed largely by the limited number of individuals with training and ability along these lines. The problem then is to formulate national policies and to take actions consistent with these policies and with principles of a voluntary manpower program in order to guarantee the most effective use of existing resources of scientific and technical personnel and to encourage the training of increasing numbers of additional scientists and engineers."

The Office of Defense Mobilization makes several recommendations. First, it outlines instructions to Government agencies to plan programs for the utilization of specialists within the framework of the present shortage; second, it urges schools, employers, and Government departments to stimulate the education of engineers and scientists. And, third, it asks industry to provide both on-the-job and off-the-job training and in cooperation with schools to develop sub-professional personnel to do work which requires less than fully-trained scientists and engineers. This far-reaching recognition of the problem by the country's top defense mobilization agency establishes very definitely the urgency and importance of the problem. There are, however, supporting data from many other sources; e.g., the National Science Foundation and the Division of Physical Sciences of the National Research Council.

The great shortage of engineers has been stated and documented in a clear and unambiguous manner by many of the country's leading experts—for example, K. T. Compton, Chairman of the Corporation of the Massachusetts Institute of Technology, in the September, 1951, issue of the *Scientific American;* Lee DuBridge, President of the California Institute of Technology, in the August, 1952, *Proceedings of the Institute of Radio Engineers;* and S. C. Hollister, Dean of Engineering at Cornell University and President of the American Institute of Electrical Engineers, at the Institute's 1952 Convention. A consensus of their concurrent statements shows that there are now about 400,000 engineers in this country; there is a current shortage of engineers of somewhere between 80,000 and 100,000; normal attrition and regular expansion in the engineering fields requires an annual influx of new engineers of at least 30,000; and the estimated graduation by the colleges of new engineers for the next few years is less than 20,000 per year. Of these new graduates probably one-half or more are R.O.T.C. students and will not be immediately available for the pressing needs of the engineering industries. From these figures it is obvious that there is no immediate hope of reducing the present shortage. There is an almost inevitable certainty that it will increase by at least 10,000 to 20,000 men per year! In speaking to the Los Angeles section of the Institute of Radio Engineers on this subject, Dr. DuBridge urged that the members of the Institute assume individual and collective responsibility for doing something about this problem, and suggested active participation by the members in campaigns to stimulate interest in engineering, particularly at the high school level, and also to attempt to raise funds for scholarships so that financial incentive could be provided to those who need it in order to obtain engineering educations.

At the annual meeting of the American Chemical Society last month appreciable attention was given to the short supply of chemists. The results of a survey completed by the Society showed a decrease in the graduation of chemists by the colleges from nearly 11,000 bachelors in 1950 to about 7400 in 1952 and an estimated 5000 in 1955! The Society urged all local sections to initiate "grass roots" campaigns to stimulate interest in careers in chemistry through local meetings, through the use of television, and by cooperation with the high schools.

The last annual report of the American Institute of Physics was concerned largely with various phases of the short supply of physicists and the increasing demands for physicists. A significant illustration of the short supply in this area is shown by the competition for physicists at the meeting of the American Institute of Physics in Chicago last fall. At this meeting the Institute's placement register recorded 201 registrants, only 4 of whom were actually unemployed, and there were over 800 positions to be filled! Although the figures cannot be construed as representing the situation for the country as a whole, the ratio in this instance highlights sharply the seriousness of the situation.

The recruitment picture is probably one of the most convincing ways in which the shortage can be demonstrated. One has merely to read the classified ads in any of the professional society journals or in some of the large metropolitan newspapers to realize that the demand for scientists far exceeds the supply. In one mid-western college it was estimated that each graduating engineer was approached on an average of 7 times with offers of prospective employment. A few of the leading members of the class had upwards of *20* interviews. It would appear that engineering graduates are no longer interviewed by employers but rather the students are interviewing their prospective bosses! A pertinent example of the recruitment picture is provided by the experience this past spring of one of the organizational units in the National Bureau of Standards. This unit was engaged in a very urgent weapons development program which required a rapid expansion of its technical personnel complement. The recruiting team conducted over 1000 individual interviews. Four hundred and eighty-five interested students submitted formal applications for employment. The Bureau's technical staff selected 107 of these applicants as suitable for employment and made specific offers to them. Twenty-two of these offers were accepted. This represents an acceptance ratio of about 20% and an effective interview efficiency of only slightly better than 2%!

The shortage of scientists is a problem not only in this country but in other places as well. The British, for example, have been giving the matter very serious attention. Their Advisory Council on Scientific Policy in its report to the Parliament in May, 1952, presented the following conclusions: "There is a pressing need to increase both absolutely and relatively the number of scientists in our industries. There is an increasing trend toward their employment in managerial and executive posts. The momentum within this trend is likely to gather strength. There is likely to be a long-range shortage of practically all kinds of scientists; every effort should be made to increase the supply with particular emphasis on chemists, chemical engineers, electrical engineers, mechanical engineers, and physicists."

The examples just presented establish very definitely the fact that there is a current serious and unfilled need for scientists and engineers. It is particularly important for members of the National Science Teachers Association to appraise the durability and permanence of this need. High school students electing to make a career in science have before them a minimum of 4 years and in some instances 8 to 10 years of intensive educational training before they become productive scientists. Hence, the impact of any effort on the part of high school science teachers to direct more of their students into scientific careers will not be felt for many years. I would therefore like to present next a few of the reasons why I believe this need for scientists and engineers is a durable one and a need more likely to expand over a long period of time than it is to contract.

Expanding Nature of the Need

The current acute shortage is, of course, closely related to the present international situation, because of the importance of science and technology to our defense effort. A forecast concerning the duration of the present international situation would be extremely difficult and of doubtful value and I certainly would not venture to make one. There is no doubt, however, that our country's ability to prevent and resist war and aggression depends in a large measure on our technological superiority. To keep ahead in the development of new and superior weapons, to maintain our leadership and capability for mass production so as to produce quickly and cheaply great quantities of both military and civilian goods, to have or to develop within our own borders all the raw materials and power needed to feed our industry and commerce—to be able to do all these things we must depend primarily on our scientists and engineers.

The great strides made in technology and production efficiency in America over the past century have been accompanied by a decrease in the total number of man-hours going into the making of a particular finished product and also by an increase in the ratio of engineering effort to total labor. Any increase in the efficiency of our production capability will most certainly be accompanied by a further increase in the ratio of engineering labor to total or unskilled labor. In this connection it is of interest to note another section of the report of the British

Advisory Council on Scientific Policy: "In the evolution of industry the trend is to increase the value of plant used per man employed. Today this index in the United States is twice what it is in Great Britain. Any improvement in the British figure demands a corresponding increase in the proportion of high-grade to low-grade staff. A more skilful labour force is also called for if we are to produce significantly more with our existing plant. In either case we need to increase both absolutely and relatively the number of scientists in our industries—men who know how to apply the latest results of scientific research to practical problems of production."

As suggested earlier, the expanding need for scientists is not dependent solely on a wartime or preparedness economy. Science by its very nature is an expanding phenomenon. Nearly every discovery or achievement in science opens new frontiers or areas for exploration. The discoveries also pave the way for developments in technology which in turn create new devices, instruments, and materials. These in turn frequently provide new tools for science and make possible an acceleration of the discovery process itself. Thus, we have between science and technology a regenerative feedback effect. There are numerous illustrations of this effect.

For example, the discovery of the principles of the magnetron and klystron led to the development of these devices to fulfill needs for radar. The availability of these instruments to generate short-wavelength-electric energy provided powerful new tools to investigate the properties of materials and the structure of molecules and the whole new science of microwave spectroscopy was born.

The field of electronic instrumentation provides perhaps the most far-reaching example of the cross fertilization which occurs in science when products of technology become available as tools. Few of the current laboratory investigations in physics would be practicable or even possible without modern electronic instruments. In addition, many new areas of research in chemistry, biology, and even mathematics are made possible by the marvelous electronic devices at their disposal. In turn, work in solid state physics is paving the way for practicable transistor development and production which will ultimately revolutionize the electronics industry.

One phase of activity involving largely electronic but also other specialties such as mathematics and mechanical engineering is looming so large and momentous as to warrant particular attention. This phase is concerned with automatic control and information processing.

Recent developments with servo-mechanism theory and practice, analogue computers, and nonlinear mechanics make it safe to forecast a tremendous increase in the scope and number of applications of automatic control techniques. These will be in chemistry, metallurgy, product and component manufacturing of almost any type, transportation, and communication. For those of you who are interested in some details of these fascinating possibilities I recommend the September 1952 issue of the *Scientific American* which is devoted in its entirety to this subject. Pertinent to the present discussion is the fact that the attainment of these goals will require increasing numbers of scientists and engineers and also that the building and maintenance of the automatic control systems of the future will demand greater availability of thoroughly trained engineers and technicians.

Large-scale automatic electronic digital computers are just beginning to become available in quantity and quality sufficient to warrant sound extrapolation as to their possibilities. They have already demonstrated that their speed, reliability, and capacity are such as to make possible the solution of physical, mathematical, and engineering problems, the size and complexity of which made their solution hitherto either impossible or impracticable. The machines open up new areas in many fields of science and in addition their maintenance and operation require large numbers of mathematicians and engineers. At the National Bureau of Standards, our computer SEAC has been in around-the-clock operation every day for two years (except last Christmas Day) solving numerous complex problems of importance to weapon development, logistic planning, engineering design, and pure physics. In the latter category it solved a host of simultaneous equations for physicists of the Johns Hopkins University in connection with a fundamental research on the relative abundance of elements. The preparation of problems to keep up with the SEAC's capacity has required a full-time staff of more than 30 mathematicians. The effective utilization of similar machines (and there is no limit to the numbers of problems to be solved) will require similar staffs.

Another possible application of digital computers, used in conjunction with large capacity magnetic recording devices, called *memories,* is in business office operations. Here it appears probable that such things as accounting, inventory control, billing operations, filing and record-keeping, and other office operations involving the routine processing of information can be mechanized to a very substantial degree. With the increasing size and complexity of many modern business office operations the necessity

(Please continue on page 285)

Helps for Counseling
YOUR Future Scientists

By MARGARET E. PATTERSON

EVERY STUDENT, planning to work in science, has dozens of questions that must be answered before he can confidently choose a career proper for his own particular set of aptitudes and circumstances.

Any science career aspirant would consider it great good fortune to automatically acquire the counseling service of hundreds of young scientists who had recently met and solved the same problems facing him.

Exactly that kind of guidance is put at the disposal of 40 high school seniors when they are named as winners in the Science Talent Search each year. Immediately these boys and girls find their circle of acquaintances expanded to include all those chosen before them and they can begin at once to direct their questions to those whose recent experiences are most like those they expect to encounter themselves.

To further facilitate this interchange of information, so essential to all phases of science, a unique publication, THE SEARCHLIGHT, goes regularly to all winners. Each winner is a contributing editor. There are 440 of them now; another 40 will be added in January 1953 when this year's winners are announced.

As editor of this publication for and by young scientists, the writer has been struck by the soundness of the advice that evolves from the group thinking of these 15 to 29 year-olds who are—or hope to be—professional scientists. Some of it may help you in counseling your own science students.

Those winners who have already completed their formal education, were asked to look back over all their schooling and name the things they now know they missed in their education. This is what some of them wish they had learned in high school:

How to study more effectively
How to elect subjects wisely
How to worry less about grades
How to reason
How to write easily and fluently
How to work harder
How to develop better reading habits

They wish, too, they had polished off these social skills during the high school years:

How to get along with people
How to relax in social situations
How to develop standards for making decisions
How to be self-confident
How to be broad-minded
How to be humble

As you might guess they wish now they had learned more science, especially mathematics, but almost as many wish they had taken more languages too. Many found themselves lacking in science skills they could have picked up in such courses as mechanics, machine shop, and mechanical drawing. A number wish they had taken time to learn to typewrite and even to write shorthand. If they had it to do over various ones would take more history, grammar, literature, public speaking, music, journalism, philosophy, and social science.

Curriculums being what they are, they admitted it would not have been—or would not now be—possible to get all these left-outs into their schedule; but they emphasized that many of these can and should be done outside of school hours during sec-

There is no substitute for experience. And anyone who has lived through planning, conducting, and following up on eleven Westinghouse Science Talent Searches has had experience! That is Margaret E. Patterson, Executive Secretary of Science Clubs of America. This article brings to you her tips and advice combed out of working with a total of 440 Talent Search winners and a much larger number of Honorable Mentions.

Science teachers, after all, are the ones who actually are on the "firing line" in identifying and guiding the future scientists and engineers in our schools today. Pat's article, we believe, will be welcomed and used by all of you. This year's Science Talent Search is now open and closes at midnight on December 27. Full details on both state and national STS's can be obtained by writing to Miss Patterson at 1719 N St., N. W., Washington 6, D. C.

Science Service Photo

Mr. and Mrs. Richard Milburn answer questions of 1952 winners. Nancy and Rick met for the first time at the Science Talent Institute in Washington in 1945 when they were both winners (this is one of two weddings of STS winners, so far). He is getting his PhD in atomic physics at Harvard where he is an instructor. She is getting her PhD at Radcliffe in physiology. She is an instructor at Tufts College and Brandeis University.

ondary school days. They urged participation in extracurricular activities that give opportunities for doing these things. Said one: "I realize now how important extracurricular activities are in developing happy, well-adjusted individuals." And because many of these winners are now teachers themselves —either formally or informally—they wish they had watched a little more closely to see "how teachers manage to inspire rather than drive their students."

The plaguing question "Shall I specialize early?" was put up for comment and the contributing editors voted 4 to 1 for diversification of curriculum in high school and undergraduate days. Their advice to younger winners was: "Explore; don't bury yourself in a specialty until you have to." "Keep a broad perspective." Even those who voted for specialization in class work admitted they got their diversification in extracurricular and out-of-school activities. Those who had themselves followed a policy midway between specialization and diversification gave the counsel: "Do both, even if it hurts." "Get an education; not just technical training."

The winners agree, almost unanimously, that since specialists in science are essential, that those so constituted are wise to concentrate on their specialty to the exclusion of all else. However, the majority are more interested in making themselves into scientists that are flexible enough to step across barriers in science. This accounts for the large number that are crossing traditional lines to make themselves into biochemists, mathematical biophysicists, geophysicists, and so on. In this way they hope to be ready to apply the tools of one science in solving the problems of another and to appreciate the problems that more than one field may share.

How to prepare for this "barrier breaking" kind of science is summed up in this advice to young scientists:

1. Acquire a good, solid background in the basic sciences including mathematics.
2. Become an authority, or at least have superior working knowledge and ability, in one field.
3. Learn thoroughly the methods common to all science.
4. Learn to work well with other people.
5. Keep your mind open to new ideas in your science, in other sciences, and in all fields by:
   a. reading widely
   b. attending lectures, meetings, etc.
   c. taking special courses to serve widened interests
   d. learning to use new scientific "tools"
   e. belonging to clubs, professional groups, etc.
   f. widening your circle of friends, acquaintances, and "contacts"

To those younger winners, distressed because their career choice is not set at high school senior age, and to those embarrassed because they change their minds a number of times during their college careers, the older winners offer reassurance by pointing to their own records. Of the 40 winners named in 1942, only nine are now trained in the science they predicted as high school seniors would be their profession "10 or 15 years from now." Of the 40 in 1943, only 12 predicted precisely what they would be doing a decade later.

Some of the forces that divert students from their original choice of a career are neatly illustrated by individual cases among the winners:

1. Increased financial opportunity: Winning the top scholarship in the Science Talent Search and subsequent scholarship and fellowship assistance from other sources made it possible for one winner to promote herself from her original choice of medical technologist to her present position as an MD serving as resident in ophthalmology at one of the finest medical research centers in America.

2. Enforced training: The Navy V-12 turned a would-be chemist into an aeronautical engineer in World War II. He has added a JD degree and is now skillfully combining law and science in his

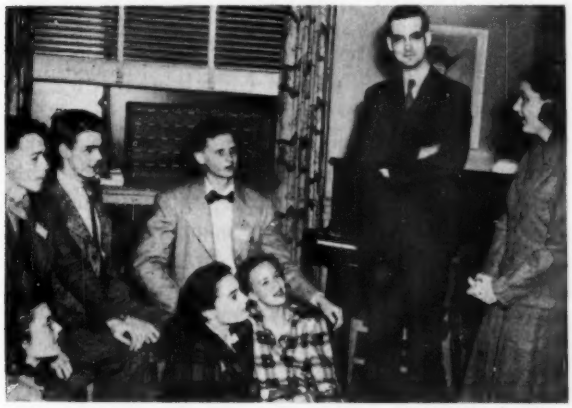
position as a corporation lawyer for one of the largest petroleum companies.

3. Opening of new fields: Nature study, directed mainly toward taxidermy at high school age, resulted in an undergraduate degree in anthropology for one winner. Despairing of earning a "living wage" in his chosen field he was ready to retrain himself as an electrical engineer when the exact job was created for him. He is now an anthropometrist in an aeronautical research laboratory. His job: fitting pilots into jet planes by applying anthropological measurements to design jet fighters for maximum comfort in the tight quarters allowed for the pilots.

4. New acquaintances: A winner, undecided on his career, heard a world-famous astronomer speak at the Science Talent Institute he attended. Although long time war service delayed his education he is now finishing his PhD in astronomy and has been for a number of years an assistant to the man who inspired his career choice.

5. Economic necessity: When a younger brother needed funds for his education one of the winners delayed his graduate work to earn money. The job he took was secret work in nuclear physics. It is now revealed he has been working on the atomic submarine and his opportunity for advanced knowledge there was much greater than it could have been for an equivalent time in any graduate school.

6. Overlooked opportunity: Seeking a career that would take him away from what he thought at the time was a drab section of the country, a high school senior decided to be an aeronautical engineer. Summer jobs in his home town during college vacations opened a field to him he had never known existed. He is now an expert on seismic detection of oil deposits and his work takes him to many parts of the country.



Science Service Photo

Marina Prajmovsky (top winner for girls in first Search 1942) and John Michener (1942) talk with winners of 1946. At present Marina, who is now Mrs. Marina Prajmovsky Meyers, M. D., is resident ophthalmologist at Columbia-Presbyterian Hospital in New York City. She is a graduate of Radcliffe and Yale Medical School. Her husband is also an MD from Yale.

Great numbers of good science teachers each year see to it that their best students accept the challenge offered by the Science Talent Search for the Westinghouse Science Scholarships. In 25 states committees of professional scientists are responsible for State Science Talent Searches that run concurrently with the national competition and see to it that hundreds of boys and girls get proper recognition and assistance to continue their work in science. Of the thousands of boys and girls entering the Search, 260 will win honorable mention and colleges and universities will seek them as students, often offering whatever financial assistance is necessary. Of course, 40 will be named as winners and will bring specially high honors to themselves and to the teachers who counseled and encouraged them.

News Item

Shown is MISS VIRGINIA BABCOCK, biology teacher at Bronxville, N. Y., High School, who was recently awarded a citation by Mount Holyoke College, her Alma Mater, at a two-day convocation on Science and Human Values. The citation read, in part: "Your enthusiastic teaching, your special interest in turning promising high school students toward college training, have made you the eagerly sought friend and understanding counselor of youth."

Mount Holyoke News Bureau

In addition to her classes in biology, Miss Babcock gives a course in life science to seventh-graders and offers a popular elective in the senior high school: biological aspects of family relationships. She teaches an elective course in photography. Following graduation from Mount Holyoke in 1931, she continued as a graduate assistant in the zoology department and took her M.A. there in 1933. She has taken various courses at Harvard, Columbia, and at the Woods Hole Marine Biological Laboratory.

Miss Babcock is active in the work of the New York State Science Teachers Association and is a member of NSTA. In these days of crying need for top quality performance in science teaching, NSTA congratulates Miss Babcock and Mount Holyoke for bringing favorable attention to our profession.

The Elementary Teacher's TASK IN SCIENCE

By DAVID BENGELSDORF

THE WORLD AROUND US abounds with many challenging events. This is not an unique situation for we have always been faced with many problems and hence many challenges to man's ingenuity. What may be considered as striking is the seemingly sudden appearance of scientific technology in the fields of human enterprise that were formerly regarded as basically "socialized." At no time in history has science played so significant and complete a part in our daily living. Nowhere in the dynamics of human interaction is there a recess where life is truly unaffected or untouched by the advances of scientific knowledge.

Those of us in the elementary schools are in the midst of preparing children for what has been defined as the "Atomic Age." We are not simply taking another step forward in progress—we are creating a new world! The impact of living in an Atomic Age knows no analogy. It is the harbinger of better things; better standards and a better life. The question we must ask ourselves as we stand at the threshold of this reality is this: "Will our children be able to share the blessings of an Atomic Age or will they fail in its fulfillment?"

THE TASK IS PRESENTED . . .

Where shall we start? How shall we go about bringing to our youngsters some realization of their task? What "tools" can we give them to aid in solving the problems posed by this new world? How shall we label and exploit factual materials so that pupils may store these facts and use them as a means of gaining knowledge and solving problems? If we agree, as we must, that our pupils shall *possess* this world of tomorrow, then we must become aware of the vital role played by science education. This task, this awareness, is the responsibility of the elementary school teacher. The teacher, in developing her concepts of the situation and in clarifying for herself those steps necessary for problem-solving, is in a position to share her experiences in the realm of science.

Where shall we start? BEGIN WHERE THE CHILDREN ARE! Begin in the kindergarten; begin with the curiosity of childhood. Science is not difficult for the child of any elementary grade. The teacher need only be aware of the child's problems in relation to his evaluation of life around him and she is ready to teach science. She must also keep in mind that the solutions to these problems are not dependent upon some ". . . permanent massive facts of life" but rather upon the *process* by which a varied fund of knowledge is applied. This need of content imposes an obligation upon the teacher to eliminate a strict dependence upon accidental and incidental learning in science education. Not only is science a method by which problems are presented and conclusions drawn after appropriate testing, but it is also dependent upon the acquisition of knowledge.

The reluctance of some educators to look upon science as a vital function in the elementary school is based primarily upon the feelings of inadequacy shared by teachers approaching this field. Harboring this fear, usually based upon the misconception of what constitutes science education, the teacher robs her children of an insight into their living world; but what is more important she loses an opportunity to solve problems and make errors. This gone, the child will lose some initiative and the school creates a void. Deny the child an opportunity to solve problems created by his living world and you destroy a motivating factor that can open many interesting and fascinating worlds.

THE TASK UNFOLDS . . .

The study of technology and its impact upon modern society cuts across artificial boundaries which separate one science from another. The teacher should recognize, however, that certain aspects of scientific thought are in the forefront of human endeavor—they are those fields which touch

The author of this article is an instructor and supervisor of elementary science education in the Pleasantville, New York, schools. He points to the need for understanding by the elementary teacher of the dynamics of the scientific enterprise and its impact on living today—and tomorrow. However, he comes "down to earth" and gives some practical suggestions on developing a plan for including science instruction in the elementary school curriculum. Many readers of *TST* will find it interesting to compare Bengelsdorf's views on incidental learnings in science with those given by Zim in an earlier issue (February, 1952).

upon the physical nature of man. The very word "atomic" denotes the need for a greater expansion of those physical sciences which are only now beginning to dwarf those of a biological nature. We must not place less emphasis upon the study of nature but more upon the study of our physical world. No longer should we expect our youngsters to learn the names of parts of the grasshopper or to identify fifteen flowers or to commit to memory the classification of plants and animals. Science, in attitudes and materials, should give to our pupils a more realistic picture of life. In this light science education should deal with the problems that are ever present in the child's life. What is "down"? What causes wind? How do we grow? What makes rain? Where does night come from? A complete technical answer to these questions is neither needed nor desired at this time. The way in which we find the answers to these problems, an approach developing the "what" and "how," is the child's science. In this manner the child will be introduced to the function of science in HIS world.

To achieve this problem-solving situation an integrated program must be established. There are limitless opportunities at each learning level for teachers to guide pupil interests in a direction that will propagate scientific adventures. The desire to label and store these experiences brings to the classroom the need for fact-finding.

To enable youngsters to meet their problems, gain knowledge, and become more aware of the world around them the elementary school science program should include the following factors.

a) The wise selection of a text and other primary readings.
b) The growing and study of living plants and animals in the classroom.
c) Establishment of a science corner with a museum and bulletin board.
d) Projects by oral, written, or manual (models) means utilized as an individual or group method of attacking problems.
e) Numerous demonstrations by teachers, invited guests, and pupils showing how they solved a problem.
f) Closer contact with the child's world with an awareness of the movies they see, books they read, and television shows they are exposed to.
g) Many field trips to neighboring establishments of scientific interests to observe how these places aid in solving problems; e.g., How we get our milk.
h) Pupil participation in school and community activities with common sharing of problem and solution.
i) The development of pupil-centered units of activity.

These items are basic in an ongoing program of elementary school science. They will provide for the child an enthusiastic set of experiences and a vast set of reading opportunities. The community activities are outgrowths of the problems that are presented by the youngster in the classroom. The methods evolved in a problem-solving procedure are designed to develop a more careful thinker and observer, reacting intelligently to his environment. This "method" will include a basic desire to solve a problem; the accumulation of facts leading to appropriate partial explanations and the logical presentation of a conclusion drawn upon facts and data.

Reference has been made to the inadvisability of dependence upon incidental learning at a time when we are stressing the need for attitudes consistent with life in a complex society. The need for planned units, basically executed and adapted to the child's need, is becoming more evident. These planned experiences are a prepared set of facts deliberately introduced to provoke a class attack upon the problem. The stimulus of this approach and its resulting response is not a controlled situation in its entirety and therein lies the opportunity for exploration and research. This does not mean the complete destruction of what is deemed incidental —it is rather the establishment of special circumstances and a strong foundation. The teacher at each level will be in a position to know, to a great extent, what the pupils' experiences have been for the previous year. The teacher will be able to develop further science activities that will not exploit areas that are more appropriate for succeeding levels. The unit development of experiences in science will further enable the teacher to check her work in science and guide pupil growth. This growth will be bounded by the teacher's selection of areas in the environment of which she desires the child to gain increased understanding through the year.

THE FUTURE OF THE TASK . . .

Science in the elementary school has come of age. It is now accepted as the responsibility of the elementary school to develop an adequate science program. Scientific attitudes no longer need be given a place in the elementary school on a purely accidental basis. The planned experience as developed in science education directs much of the child's activity toward certain ideas with a subsequent development of desired learnings. In avoiding education based upon extreme opportunism we are able to give our students a sound foundation upon which the experimental act may rest. With this in hand

the child will develop attitudes and procedures that will enable him to face his world. When carried through to a higher level this method does bring its reward in pupil maturity. The unit should be set up as a source and not an inflexible path. It must raise science problems in connection with familiar experiences and phenomena. Each unit will bring additional problems to the fore and call for an additional fund of information and experiences. The teacher can avoid the pitfalls of rigid and formal instruction by exercising the imagination and curiosity of all children. The teacher in turn must use her experiences and imagination to provide a mobility of ideas. There is no subject which allows the teacher greater freedom in developing effective and progressive methods of teaching than does science. Science itself is progressive. Within the problem-solving frame of this broad science we may place not only the interaction of a schoolwide program but also the individualism of the questions which are of concern to our little people, who, after all, will soon be our big people—seeking more valid answers to further problems.

An Inductive Approach to General Science Through Photography

By HERBERT F. A. SMITH

Mankato, Minnesota, State Teachers College

Last summer at the Mankato (Minnesota) State Teachers College we conducted an experimental junior high school class in science. The approach was through photography, but the purpose of the course was not primarily to teach photography. The chief purpose was to teach children to observe more keenly, to present evidence more clearly, and to use facts more effectively in drawing conclusions from scientific study.

As the term was to last only five weeks, we plunged immediately into a study of the behavior of light in instruments such as the camera and the enlarger. During the first period together, each child of the eighteen-student group was supplied with a small convex lens and an experiment sheet with directions and questions such as the following:

> When the lens is examined, does it appear to have two flat sides, one flat and one curved side, or two curved sides? If there is a curved side, does it curve inwards or outwards?
>
> If the lens is held so that light from the sun passes through it onto a clean sheet of white paper, does the light seem to come to a point? Does it seem to spread over an area greater than that of the lens? Is there no apparent effect?

The children were encouraged to write out their own findings on the experiment sheet and to draw and write their own conclusions; most, it appeared, did. After some time was allowed for this work (there was additional material on the sheet to absorb the interest and time of the more able pupils), the group was gathered together for discussion.

The children soon concluded that, as light went through the lens, the rays were bent toward the center of the lens. It occurred to some pupils that the light rays which streamed through the windows were parallel and were not bent in passing through the glass. After some consideration of this additional evidence, it was concluded that the explanation of this apparent paradox lay in the fact that the lens had a curved surface while each window pane had two flat surfaces. From this consideration the class generalized that when light passes from one medium to another, under some conditions, the light rays are bent; it is possible to control these conditions. The teacher was then able to guide the children to a realization of the great possibilities opened after it had been determined that we can manipulate light rays by the use of variously shaped pieces of glass or plastic which we call lenses.

It would seem that an assignment to make a pin hole camera was advisable at this time, but this assignment was not made. Many of the children had made such a camera in the lower grades and many of them had heard a good deal concerning this instrument. Several boys and girls volunteered information and were able to explain the construction and operation of a pin hole camera. During the discussion, this question was raised: "If a pin hole

camera works, why go to the expense of putting a lens in a camera?" One boy was quick to point out that a pin hole admits a very small amount of light and therefore permits little effective use of the camera, while a lens allows a great deal more light to enter the camera and consequently permits far more effective use of the camera.

The foregoing detailed description of the method of teaching which we used need not be continued; this example will suffice to indicate the inductive approach which was the basis of our method and which proved most successful throughout this and other courses. Children thoroughly enjoy gathering evidence, drawing and testing hypotheses, and talking over their results among themselves. The conclusions drawn by one child may be faulty and often are, but those drawn by a group of children working within the limitations of their equipment and experience, and under expert guidance, are surprisingly sound. It hardly need be pointed out that the training children receive in observation, recording, and testing is invaluable.

It might be well to speak briefly of the darkroom at our disposal. It was small and had a minimum of equipment: three trays, two ferroplates, a contact printer, a print washer, and a mediocre enlarger. The enlarger was once worth about forty dollars; a second hand one in as good condition could be bought for considerably less. Apart from the enlarger the equipment could be purchased new for about fifteen dollars.

Group Work

The whole group of pupils and nine student teachers was broken up into smaller working groups so that only a small number was in the dark room at the same time. Other activity work occupied the groups who were not in the darkroom at the time. One group worked on a class newspaper, another worked on a mural, and still others went out into the community for pictures of special interest. It was so arranged that each person had an opportunity to work in the dark room several times each week. Both the pupils and the student teachers were taught to make contact prints and each was afforded enough practice to be able to turn out an acceptable print from a fairly good negative. After experience had been gained in contact printing, the group went on to enlarging. This proved the most fascinating aspect of our efforts to many of the children and to some of the adults.

Because we had only one tank in which to develop all our negatives, this work demanded much time. As a matter of fact, many of our negatives were developed in the afternoon when attendance was purely voluntary. It must be said, though, that by thus giving the children enough time to work carefully, practically no exposed film was spoiled. It became quite evident that children of junior high school age can follow directions well enough and are also imaginative enough, to do very creditable work in photography.

A Tool of Science

Once the study of photography was launched, the children were led to a new concept: "Now that you have learned a little about photography you know a new tool of science, a new way to tell about something. How can we best use this way of telling about things during this summer?" The result of the subsequent discussion indicated that the group felt that we should study our own community and that it seemed better to go out into the community to get pictures rather than to try to photograph evidence within the school. After this general pattern had been established, the group broke up into five smaller groups who then met separately to outline practicable approaches to some problems in the community.

When the whole group had convened once more, the ideas from each of the smaller groups were written on the board and it became evident that a common thread of thought ran through the ideas presented. This was not entirely coincidental; there had been a spectacular flood in the area just two months previously and there were still many signs of destruction to be seen and photographed. Many of the questions raised dealt with flood control, soil conservation, property conservation, and so on. The group determined to study flood control and water conservation first and felt that the answers to many of their questions could be found by studying the remains of a dam which had been destroyed at the conjunction of the Blue Earth and Minnesota Rivers. As a matter of fact, the remains of the dam presented a real problem to the city. The dam had been built some years before for scenic purposes and some landowners along the river felt that it had done more harm than good. These people and some others wanted the remains removed; still others believed that it was more desirable to restore the dam.

As part of the preparation for a trip to the dam, the teacher arranged the questions raised by the children concerning the problem so that their answers would lead to other questions and ultimately

to broad concepts of the effects of running water. These questions comprised a second experiment sheet, a copy of which was given to each pupil and student before the group left the school.

At the site of the dam, the children were inquisitive and active. Each child had a camera or the privilege of using one and each had the opportunity to take several pictures.

For the most part, the negatives exposed on this first trip were taken to commercial firms for development. The mistakes made by novices in printing mean only a waste of paper but mistakes made in developing negatives mean that the image imposed on the film is destroyed and, of course, the pictures are lost. After the children had obtained their developed negatives, they could hardly wait to get into the darkroom and make prints. Each was exceedingly proud when he was able to take an acceptable print home to his family and say: "This is a picture I made. It shows the debris piled up against the Sibley Park Dam." Some of the pictures conveyed the impression of the ruined dam so well that a group determined to paint a mural to express the experience more abstractly. This project in itself took up much of the time of some pupils for the rest of the session but the result was an achievement which, we felt, was worthwhile.

Project Conclusions

Much evidence concerning the effect of running water was presented by the children both through words and pictures. From this evidence, and the discussion it brought about, the boys and girls reached conclusions which were essentially as follows:

> Rivers always carry some sediment, but more sediment is carried by rivers in flood stage because the rivers eat more deeply into their banks and swiftly moving water can carry more sediment than can water moving at a moderate speed. As the flood recedes and the water moves more slowly, some of the sediment is deposited. This means that good farm land may be carried away from the farms and deposited where it is in itself destructive. Since water which is made to move more slowly by an obstruction such as a dam, deposits some of its sediment, the dam in question caused the river to raise its bed immediately upstream from the dam and this possibly contributed, to some small extent, to the flood damage. More serious, perhaps, was the fact that the superstructure of the dam (a walk built over it with steel railings on each side) trapped much of the debris and, in reality, thus built a much higher dam.

Pictures of the partially destroyed walk and of the great tree trunks and other large objects piled against the wreckage were good evidence to support the conclusions which had been reached.

The study of soil and water conservation which was based on the evidence supplied by the excursion to the dam and the surrounding area was followed by a similarly conducted study of property conservation. There were many houses and streets in the city which yet showed signs of flood damage —eroded yards, caved-in basements, and collapsed pavements. Of course, these objects lent themselves to pictorial treatment but, beyond that, the pictures of them which were made produced evidence to answer some questions and to raise still more. As a result of this study, a delegation of children visited the Municipal Building and interviewed the mayor regarding the cost of rehabilitation, the aid granted by the state and federal governments, and the part played by the Red Cross, the Salvation Army, and other such agencies.

In the five weeks available there was opportunity to use only a small fraction of the great number of ideas brought forward by the children. One unit on human conservation which would have included a study of sewage and garbage disposal, the hospitals and clinics, and the safety program of the city was hardly touched. Similarly wild life conservation, both plant and animal, offered a very attractive field for study through photography.

During the last day of school the boys and girls were shown the motion picture "Near Home" (IFB)—the story of a group of boys and girls in an English school who went out and made a study of their city of Bishop Auckland. Our pupils were able to see many parallels between the situation in our school and that of the school in England. In each case the pupil was given the opportunity to go out of the school building and find evidence for himself, to report this evidence, and to draw conclusions. There were differences, too. The English children presented their result as a bulletin board exhibit; our children presented theirs in pictures and in a newspaper. The English school is in a center where recorded history goes back 2000 years while our pioneer days are scarcely a century behind us; yet each locality tells much to him who takes the time to study what is presented.

In a discussion after the film, a student teacher asked the group if they, the pupils, preferred the way of learning which they had experienced during the summer or the more conventional methods. One boy was heard to whisper scornfully to his neighbor, "What a stupid question!"

DEMONSTRATION TO SHOW
Action of the Valves of the Heart

By DANIEL S. THORPE*
Washington High School, Atlanta, Georgia

The action of the valves of the heart can be vividly demonstrated by the construction and use of a moderately simple apparatus. Plastic tubing is easily handled since it can be sawed, shaved, or glued. A plastic known commercially as "acetate butyrate" is very easily worked, and can be fastened together by the use of ethylene dichloride. This particular plastic can be bent into various shapes by using either hot sand or hot water, or by heating above an open flame.

A plastic tube (2¼ x 3″) closed at one end with a round window (sheet plastic) is placed in the open left auricle, and another tube (1¼ x 3″) in the aorta of a large beef heart. A tube (½ x 21″) attached to a large rubber bulb is inserted in the cavity of the left ventricle through its apex. The other end of the tube carries a small electric lamp, well insulated, to illuminate the interior of the left ventricle. A 7-watt lamp is sufficient to show through the translucent valve leaflets or cusps in both the interior of the auricle and the aorta. Each plastic tube (with window) has a side tube (¼ x 2″) connected by rubber tubing to an aspirator bottle (for pressure) suspended above the heart. The plastic tube (with window) tied into the auricle is connected to a rubber tube at the bottom of the bottle; the plastic tube (with window) tied into the aorta opens at the top of the bottle. A Y-tube is inserted in the rubber tube at the bottom of the bottle. One end of the Y-tube is connected to the side tube projecting from the cylinder (with window) in the auricle. The other end of the Y-tube is connected to a side tube projecting from the plastic tube carrying the rubber bulb. A cylinder enclosing a one-way valve is inserted in the latter tube leading from the Y to just in front of the rubber bulb. Check all connections and make certain the two cylinders with windows are tied securely. The heart is placed in a shallow pan to catch the water in case of leaking.

Water is poured into the bottle until the entire system is filled. A moderate supply should be left in the bottle. Alternate compression and release of the rubber bulb will imitate the action of the left ventricle. The action of the valves will be seen through the windows as the pressure of the water rises and falls.

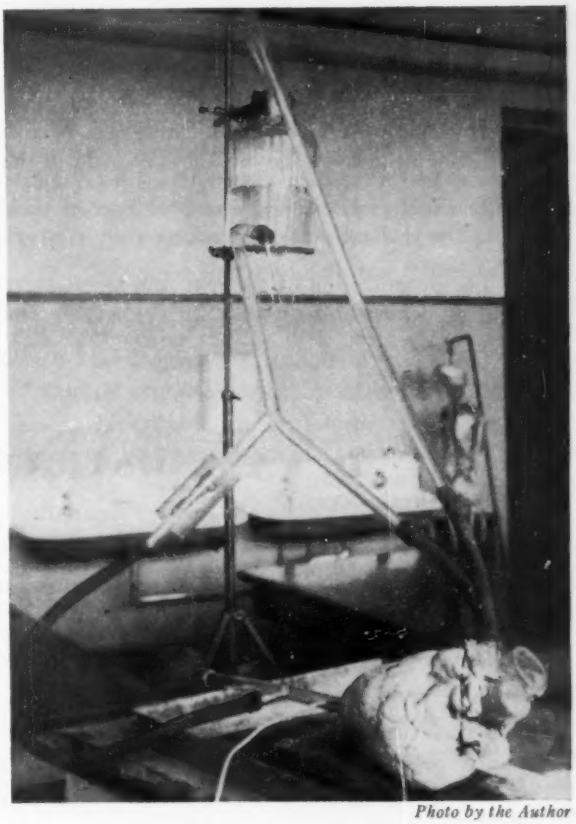


Photo by the Author

* Mr. Thorpe's paper was entered in the 1952 NSTA-ASM Awards for Teachers contest. The judges selected it for Honorable Mention recognition. Mr. Thorpe gave this demonstration at a "Here's How I Do It" session of the NSTA Regional Conference held in Atlanta, Georgia, October 16-18.

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G. Fowles, Latimer Upper School, Hammersmith, London, in *Lecture Experiments In Chemistry*. P. Blakiston's Son & Co., Inc. 1937.

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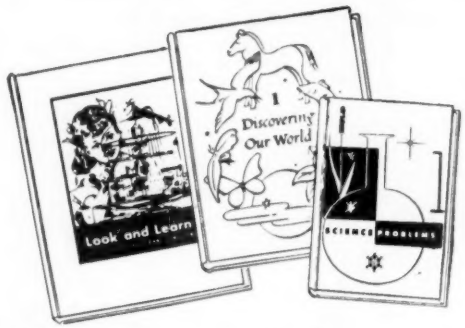

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The Problem of the Periodic System

By OWENS HAND BROWNE

Professor of Chemistry, St. Mary's School and Junior College,
Raleigh, North Carolina

Since the days of Döbereiner, Newlands, and Mendelejeff, scientists have engaged in the fascinating pastime of marshaling the atoms. The resulting forms of the periodic table have been about as numerous as the contestants. The elements have been arrayed and displayed in ranks and files, rows and columns, families, groups and subgroups, short periods and long periods, rectangles and triangles, concentric circles, inverted pyramids, and ever-ascending spirals and figure eights.

Each of the published tables has its good points and bad, its advantages and defects; but to date none has proved to be really satisfactory. A study of many of these tables has led the author to the conclusion that students of the matter have been hampered by the adoption of several false premises. Among these may be mentioned the following:

1. Atomic weights shall constitute the basis of the arrangement.
2. The periods shall be of equal length, giving a rectangular table.
3. Each period shall begin or end with a rare gas.
4. Helium is a member of the family of rare gases.

In constructing the accompanying table, three rules are followed:

1. The elements shall be arranged in the ascending order of the atomic numbers.
2. The lengths of the periods shall be determined by the Rydberg Series, $2n^2$.
3. There shall be two periods of each length.

As far as the first two rules is concerned, this table does not differ from the Thomsen-Bohr table. However, it is the third rule which provides the key to the solution of the problem.

An examination of this table shows that it has most of the advantages of other tables. The order of atomic numbers is followed exactly and the conventional periods and families appear. The table is flat, not three-dimensional. Although not as compact as a modern Mendelejeff Table, it is no more extended than the Thomsen-Bohr Table. In fact, this table closely resembles the Thomsen-Bohr Table except for the fact that the periods end with the alkaline earths instead of the rare gases.

Let us continue an inspection of this new table to see wherein it differs from others:

1. We note, first, that the arrangement of the elements is mathematically precise in numerical order and placement. By following the three rules, one may place the elements in their correct places without exception. There is no jumping from column to column or row to row.

2. This table, unlike most other tables, is neither rectangular nor triangular. Its shape, as one may see by inspection or determine from the Rydberg formula, is parabolic.

3. The table is divided into sections by vertical lines which mark the beginnings of the periods of different lengths. These lines separate the families into lots which, as is the custom in classifying families, we shall call "orders". The orders are numbered as they appear and run from right to left. As we shall see later, this classification by orders has an important significance from the standpoint of atomic structure.

4. The families are numbered in the order of their appearance. The families do not fall into numerical order but within the respective orders they run numerically from left to right.

5. The periods are numbered in the order of their appearance. Here we note an important difference from other tables. Except for elements in the first order, all elements belong to the period next higher than those in which they are ordinarily placed. For example, the elements boron through neon are usually placed in the second period, whereas we see that they actually belong to the third.

6. This table settles the classification of certain elements. It shows definitely that magnesium belongs to the calcium family, not the zinc family. It shows that cerium is a rare earth and that, contrary to custom, lanthanum is a rare earth while lutecium is not. It proves, as has recently been suggested by various workers, that the trans-radium elements constitute a new series of rare earths. It shows that the neutron and the alpha particle do not belong in the table. Finally, strange as it appears, it indicates that helium is not a member of the family of rare gases.

Order	4																	
Family	19	20	21	22	23	24	25	26	27	28	29	30	31	32	9	10	11	
															21 Sc 45.10	22 Ti 47.90	23 V 50.95	
															39 Y 88.92	40 Zr 91.22	41 Cb 92.91	
	57 La 138.92	58 Ce 140.13	59 Pr 140.92	60 Nd 144.27	61 Pm 147.	62 Sm 150.43	63 Eu 152.0	64 Gd 156.9	65 Tb 159.2	66 Dy 162.46	67 Ho 164.91	68 Er 167.2	69 Tm 169.4	70 Yb 173.04	71 Lu 174.99	72 Hf 178.6	73 Ta 180.88	
	89 Ac 226.	90 Th 232.12	91 Pa 231.	92 U 238.07	93 Np 239	94 Pu 239.	95 Am 241.	96 Cm 242.	97 Bk 243.	98 Cf 244								

7. Let us consider, from the standpoint of atomic structure, the significance of the four orders of elements. Luder[1] and, later, Babor[2] have constructed tables on the basis of the "differentiating electron". In their tables, the elements are distributed between three sections according to the energy level taken by each added electron as the atoms of the successive elements are "built up" by the addition of new elementary particles. An examination of the table of electron distribution[3] will show that a somewhat similar relationship exists in the present table. It will be noticed that, except for irregularities caused by valence changes, all of the elements in any order differ in electron distribution from other members of the same order and period by the number of electrons in the same energy level.

8. Heretofore, the family of rare gases has usually been considered to mark the border of the table. Note the new position of these elements. The family now serves as the backbone of the table, separating the most active metals and nonmetals, while its old place is taken by the alkaline earth family. Why should the alkaline earth elements serve to terminate the various periods? A study of the table of electron distribution shows that in each of these elements the electrons have a symmetrical distribution between the various energy levels. This is not the case with any other elements. It appears then that each period is ended, not by an element whose outer electron shell is complete, but by one whose electrons are symmetrically distributed.

As is often the case, the simplest solution of a problem seems to be the best. The Periodic Table constructed entirely on the Rydberg formula appears to be superior to any other.

[1] Ludor, W. F., *Jour. of Chem. Education*, 20:21. 1943.

[2] Babor, J. A., *Basic College Chemistry*, Thos. Y. Crowell Co., New York. (1946)

[3] Getman and Daniels, *Outlines of Physical Chemistry*, Seventh Edition, 639, John Wiley and Sons, Inc., New York. (1946)

". . . the problem, not the recitation or laboratory exercise, is the logical and practical unit of instruction, as it should be. The aim of the student should be to arrive by correct scientific thinking and experimenting at the solution of a significant problem."

George R. Twiss in *Principles of Scientific Teaching*, The Macmillan Co., 1917.

PERIOD	1		2		3															
	1		2		3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	
1	1 H 1.008		2 He 4.00																	
2	3 Li 6.940		4 Be 9.02																	
3	11 Na 22.997		12 Mg 24.32		5 B 10.82	6 C 12.010	7 N 14.008	8 O 16.000	9 F 19.00	10 Ne 20.183										
4	19 K 39.096		20 Ca 40.08		13 Al 26.97	14 Si 28.06	15 P 30.98	16 S 32.06	17 Cl 35.457	18 A 39.944										
5	37 Rb 85.48		38 Sr 87.63		31 Ga 69.72	32 Ge 72.60	33 As 74.91	34 Se 78.96	35 Br 79.916	36 Kr 83.7										
6	55 Cs 132.91		56 Ba 137.36		49 In 114.76	50 Sn 118.70	51 Sb 121.76	52 Te 127.61	53 I 126.92	54 Xe 131.3										
7	87 Fa 223.		88 Ra 226.05		81 Tl 204.39	82 Pb 207.21	83 Bi 209.00	84 Po 210.	85 At 211.	86 Rn 222.										
8																				

PERIOD	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4	22 Ti 47.90	23 V 50.95	24 Cr 52.01	25 Mn 54.93	26 Fe 55.85	27 Co 58.94	28 Ni 58.69	29 Cu 63.57	30 Zn 65.38						
5	40 Zr 91.22	41 Cb 92.91	42 Mo 95.95	43 Tc 96.	44 Ru 101.7	45 Rh 102.91	46 Pd 106.7	47 Ag 107.88	48 Cd 112.41						
6	72 Hf 178.6	73 Ta 180.88	74 W 183.92	75 Re 186.31	76 Os 190.2	77 Ir 193.1	78 Pt 195.23	79 Au 197.2	80 Hg 200.61						
7															
8															

Announcement

CONSERVATION EDUCATION WORKSHOP

In connection with the annual meeting of the Central Association of Science and Mathematics Teachers, the National Association of Biology Teachers and CASMT are co-sponsoring a workshop on conservation education in Chicago, Illinois, November 28, at the Edgewater Beach Hotel. All persons interested are invited to attend. The program is as follows:

10:30 a.m. General Session of Biology Section and Conservation Section. Chairman—Ruby Fremont
"The Ecology in Conservation"—Howard H. Michaud, Purdue University

11:00—12:00 Panel discussion led by Richard L. Weaver, University of Michigan, Project Leader, Conservation Project of NABT.

"Resourceful Techniques in the Teaching of Conservation"

Panel Members
Illinois—Robert Smith, DeKalb Township High School
Michigan—Betty Wheeler, Mt. Pleasant
Ohio—Robert Finlay, Ohio Dept. of Education
Indiana—Prevo Whittaker, Indiana University
Wisconsin—Bernard Wieval, Wisc. State College

2:45—4:30 p.m. Conservation Work Conference

Part I

1. Objectives of NABT Conservation Project—Richard L. Weaver
2. Progress Report of State Chairmen from Ill., Ind., Ohio, Mich., and Wisc.

Part II

1. Development of Plans by State Work Groups
2. Report of Work Groups
3. Summary—Howard H. Michaud

SOME PROBLEMS OF SECONDARY SCHOOL CHEMISTRY

By CARROL C. HALL

THE GROWTH of man's knowledge is never static. This is particularly true of our physical world in the study of which chemistry looms large. Consequently, the presentation of material in this field at the secondary school level, along with the organization of the subject matter, must be reviewed at regular intervals, else instruction falls behind in maintaining pace with the modern trends of scientific thought.

The rapid advance of scientific thought both in its qualitative and quantitative aspects has been accelerated in the last decade. The new developments place a great burden on the conscientious worker in this field, who as an instructor of our youth is faced with a terrific and almost overwhelming responsibility.

Background

In 1937 the author reviewed a large number of then-existing high school textbooks in chemistry, studying their organization and incidentally observing their subject matter content. That study, covering a twenty-year period of textbook publication, revealed that the content of subject matter had changed but little during that interval, the most noticeable influence appearing to be that of the educators, changing organization from the traditional chapter presentation to that of unit organization with the units covering larger areas of the subject matter.

The 1937 study was reported in the *Journal of Chemical Education* and several other science education periodicals.

Recent Developments

Should an investigation be conducted as of today repeating the 1937 study, it is evident that there would be a dramatic change in the high school texts —both in format and subject-matter content and organization—of rather striking proportions.

Then, too, there has been a dramatic attempt to present the newer ideas of atomic structure, radioactivity, electrochemistry, periodic table, etc., in these books and to develop them for the mass education of youth of high school age.

The typical high school text is rapidly becoming encyclopedic in nature. The fact is that they are continually added to and there is reluctance to (or fear of) eliminating previously presented material from the contents.

The earlier drive to section off the subject matter into large, basic units has broken down, although the "unit" appears to stay. High school chemistry, unlike physics, has never been developed along the lines of basic areas of instruction; i.e., mechanics, heat, sound, light, electricity, and magnetism.

Without these basic areas of presentation and organization (of course, inter-related by the very nature of science) the teaching of high school chemistry is handicapped, the students confused.

Question

The fundamental question is: Can we develop these broad areas of study, necessarily few in number, for the proper presentation of secondary school chemistry. It is an organizational problem of some magnitude beset with a large number of factors that militate against the idea.

It is the purpose of this discussion to check some of the problems that must be considered and to attempt in some measure to find a solution.

History

Behind every existing textbook today there is a history. Somewhere in the past a college text was

Mr. Hall is teacher of chemistry in the Springfield, Illinois, High School; he is a veteran of many years experience. He has been a student of the organization and presentation of high school chemistry and in this article gives us the benefit of his experience, inquiries, and recommendations on a wide variety of problems. His emphasis on the textbook in chemistry probably stems from the fact that his experiences have led to services as an editorial consultant on two textbooks and as co-author of a laboratory work-guide, as well as his recognition of the fundamental importance of the text in most courses as conducted today.

Mr. Hall was a Westinghouse Fellow at Massachusetts Institute of Technology the summer of 1952. This paper was originally prepared for presentation to the entire group of MIT Fellows.

rewritten to meet the needs of the secondary school. All subsequent texts show the influence of this background. Today, however, there is evidence of a deliberate attempt to develop texts on new lines, eliminating to a large extent the college and university influences; to forego the historic or chronological presentation of the subject matter and to emphasize the basic fundamentals characteristic of physical science and to exclude much of the descriptive material formerly included.

Colleges Lead

This movement in text revision is most pronounced at the college levels. There is good reason for this. College instructors, as a group, are less restricted in their work than are secondary school teachers.

There are a number of limiting influences on high school instruction. The entrance exams, the accrediting agencies cannot be ignored; and the publishers, who must protect their investments, will not be pushed too far from the conventional path.

The average high school instructor has little time for "on the job" re-working of his instructional materials. Chemistry may be but one of his subjects taught; and, in many cases, the background of the instructor is inadequate.

Importance of Text

Few secondary school teachers work from self-prepared outlines; they lean on published textbooks. This is not only the easiest solution to their problem, but lends authority to their instruction in the eyes of their pupils. Textbooks are in fact the courses of study prepared by outside hands. Teaching as now generally practiced has lost its professional aspect of the past. Teachers are technicians —surface workers, instead of true educators steeped in knowledge that is presented with a background of philosophical understanding.

Administrative Difficulties

The growth of attendance under compulsory laws of pupils of secondary school age has witnessed the growth of a great managerial class called school administrators who control our schools. The idea of a teacher as a prime factor in the conduct of the school has slipped into the background. This has had disastrous effects on the presentation of the basic sciences.

Instructors are today faced with the 60-minute class period, the abolition of the 2-hour laboratory session, the interfering factors of the school program which make secondary academic instruction difficult.

In addition, the great growth of quasi-administrative offices—deans, counselers and the like—has further shoved into the background the importance and weight of decisions made by faculty members who still cling to the old-fashioned notion that instruction in the basic subjects is the real function of the school.

Chemistry teachers are swamped with ill-prepared pupils, credit seekers, and a whole generation of children who have never had the thrill of real accomplishment in the activities of intellectual discipline.

Here again, it becomes increasingly important that inventory be taken to determine what is being done and why. The text, which is for most teachers the course of study, is perhaps the most important single teaching tool.

Conflicts

Thinking in the educational aspects of teaching secondary chemistry is extremely hazy. That confusion stems from several directions. First, from the chemistry teachers themselves; second, from the school administration; and third, from college instructors. All groups are generous in their advice on the presentation and organization of the subject.

Instruction varies widely for high school levels. It varies from a "consumer" course designed as a "catch-all" to specialized courses for college preparatory students and to instruction designed to train laboratory technicians.

Most school courses are compromises designed to reach the average student—still too hard for the poorer ones and too simple for those of above-average intellect. Since this is true, the loss to this last group is a national tragedy.

Philosophy

Shall then the instruction as outlined by the textbook be directed toward the college preparatory student, taking the mine-run group as they come; or, shall it be designed to give the student a basic preparation for further study in the field?

Shall it be assumed that what is good for the college preparatory student is also good for the non-college student?

Shall we divide the classes into two distinct teaching groups? This is frequently tried, and in many cases runs up against almost impossible situations brought about in the organization of the school program.

Plan

For purposes of the present discussion, let it be assumed that the chemistry course is for college preparation; that the student group is selected; and that the course is preceded by one year of high school physics and by three years of high school mathematics.

Under such a program the high school textbook could be severely revised and there would be in effect a reorganization and a new presentation of the subject.

Under such a program there could be a minimum of three units per semester or six in one year of study; or a possible maximum of four units of study per semester and a total of eight for one school year.

These major areas of study could be planned to coincide with the typical school schedule; i.e., the five-day week; the one-hour period; and accommodate the usual run of interferences and holidays.

Material Eliminated

It would seem logical that under such a program, detailed study of the metric system, the gas laws, and extensive reviews of density, specific gravity, and similar physical properties could be reduced and such ideas used only in their direct application to chemical phenomena.

Serious consideration would be given to leaving out considerable amounts of descriptive material (the detailed study of various members of the period table and the related compounds of common chemical elements). While considerable time is now consumed in studying representative elements from the periodic table, more time could be spent in the study of the table itself and in its use as a chemical tool.

The traditional high school textbook gives a great amount of space to the historical aspects of chemistry. High school pupils are not historically minded; historical appreciation comes with maturity. Consequently, the present outline texts are popular with the students, inasmuch as they eliminate the historical material. The history of chemistry is important to the instructor who can use it to point up certain discussions and demonstrations, or is valuable for student project work if any is done. Therefore the new proposed course of study (or text) will abandon the chronological-historical aspects of the study.

Also to be eliminated are the consumer and industrial chemistry items as major aspects of the presentation. These aspects of chemistry serve only to point up the study—and stem mainly from the qualified instructor; they are not the end in themselves. Only as the students discover the consumer and industrial applications themselves as incidental to their basic study do such items become meaningful.

Material to Be Added

There is no question that the slant of the new approach to secondary chemistry must be in the merging of the two sciences, physics and chemistry. The line of demarcation is purely an arbitrary one. Yet, the idea of a course in physical science is objectionable as it requires generalized thinking which is possible only with the background of more isolated information and facts. Current courses in high school physical science, usually given in the upper two years, fall far short of what is actually needed.

There must be far greater inclusion of the mathematical concepts and interpretation of chemical information. No one will argue the fact that increasing attention must be paid to atomic structure from the thoroughly theoretical point of view.

Electrochemistry must loom large in such study, as well as all phases of the study of solutions. Modern concepts of ionization, equilibrium, and acids and bases must be introduced.

The use of mathematical expressions should be stressed and a definite follow-up given to the previous training in this field.

While the foregoing list is not complete, it does serve to illustrate the type of work that must be done. A course of the general nature of that described should replace the conventional first year of chemistry in the secondary school as an integral step in the whole line of chemical education—an idea not now commonly in vogue.

Continuity

Lacking at present there is the continuity of idea in the presentation of secondary chemistry that is essential for a well-integrated basic course. This is the result of a sampling process that takes place in the building of the text; the whole comprehensive field of chemistry is sampled to the detriment of its organization at the secondary level.

A continuity of ideas—in mathematical expression, in nomenclature, and, above all, in the discussion of relationships of basic ideas—is absolutely essential. This can only be achieved to any degree of success by first arriving at a fundamental point of view, in harmony with modern chemistry at the higher levels, and then setting about to achieve that end.

A typical problem to be met with in this phase of the work would be the definition of an element in terms of atomic structure. The current practice is to give an out-dated definition or to give two definitions, one early in the course and one somewhat later. Oxidation and reduction may be well considered in this light.

Atomic Structure

The place of instruction in the modern atomic theory is one of concern at the present time. Frequently it is treated somewhat as an appendage to the more classical presentation, or is developed as a

(Please continue on page 287)

Elementary Science Can Be Dramatic

By CAROLYN NUNN

Duarte School District, Glendora, California

SCIENCE can be dramatic and it has a high entertainment value. Science experimentation holds as much attraction as magic out of a hat. Probably for the same reason. Something happens, and we like to watch phenomena either to be mystified or instructed.

In the case of science, interest and entertainment prevail. This interest was the basis for a program presented by a seventh grade class to their schoolmates and patrons of the Duarte School District. They took teakettle, candle, bottles, soil, tin cans, electric plate, and sundry school-made scientific equipment into the auditorium. A well-planned framework of explanation and running comment accompanied the scientific experiments the children performed on the stage.

This dramatic presentation of science was the culminating activity of a social studies unit on textiles covering a semester's study. Science and music that were unit correlations served as the dramatic framework and emotional appeal of the program. They supported interest in a rather long presentation of factual material gathered in geography, history, related arts, conservation, health implications, problems of workers and manufacturers, producing, processing, and transporting—i.e. all the ramifications of a half year's study of the textile industry.

To avoid being a rehash of a unit on textiles this article will be confined to the part science played in stimulating and holding interest. The science experiments fell naturally into two groups. One group dealt with fabrics and their processing. The other dealt with soil as the support of all living things. The entire program was hinged on these two basic divisions since the class chose the science aspect as the mainspring of their program.

Two chairmen led round-table discussions based on the reports pupils had prepared in their social studies class. All factual information was divided on the basis of its relation to the practical science of textiles or the conservation angle of soil as *the* support of all human activities.

Since they were presenting reports for an audience the pupils decided to be more formal than they had been in the classroom. This was because no one wanted to be caught in a fumble when the conversation ball was tossed to him. Consequently a script was worked out so that integration was established between the discussion and the experiments. So closely planned was this correlation that there were even experiments within experiments!

Letha Springer's committee performed two groups of experiments dealing with tensile strengths of various yarns and with dying and fading tests of materials and colors. A display of the results of burning tests also held the attention of the audience.

Ralph Cesena and Rosie Ybarra demonstrated that thickness of yarn is not always a criterion of its strength. By pulling on yarns of different twists

Using easily constructed equipment, Bill Biller and Ronald Schlax produce artificial rain and show its effects upon unprotected soil.

Photo by Vee LeDuc

Photo by Vee LeDuc

Donna Mae Wilkinson and Nadine Knight perform a simple experiment to show the effect of sudden temperature change in glass. Note the improvised "lab table" they are using.

they were able to show that tight twists are stronger than larger loose twists.

Nicky Poupon and Bethany DeBow further demonstrated this point by adding weights to suspended yarns. The breaking points helped establish some of the facts a committee was presenting on problems of cloth manufacturing.

Aurora Garcia and Kenneth Saunders told about the dyeing and fading of cloth. Much of this experiment depended upon quick showing of samples as time is required to dye and fade cloth.

Chairman Mary Patzer opened the way to the second group of experiments. The first experiment dealt with the making of soil. The ingredients of good soil were mixed in full view of the audience.

Interrupting this procedure in the strategic part of the discussion, Donna Mae Wilkinson and Nadine Knight amplified the facts on formation of soil by demonstrating the effect of extreme changes of temperature. A teakettle was steaming on the electric plate plugged in the front of the stage. This boiling kettle had been an interest holding prop throughout the program. Donna Mae carefully poured water over the ice filled bottle that Nadine held over a pyrex pan with metal tongs. The splintery sound carried in the auditorium.

Bob Ferro then continued the soil mixing activity. Equal amounts of different grades of dry soil were put in flower pots that were set in glass jars. Equal amounts of water were poured into the flower pots. Attention was called to the relative amounts and rates of seepage. The glass jars easily exhibited the amount of water that seeped through.

Next the experiment was repeated by pouring equal amounts of water into the flower pots again. Conclusions were pointed out as the audience observed the rates and amounts of water seepage through moist soils of different kinds.

Two boys provided ingenious scientific experiments to show erosion, its action, and prevention. In order to perform this experiment Bill Biller used a board about twelve inches wide by sixteen inches long. He nailed half inch strips on the two sixteen-inch sides and across one other side. It looked something like a smooth washboard. A lump of soil made of layers of small rock, pebbles, sand, and clay soil was put near the top of the board.

This board was then inclined at a fairly steep angle. Tin cans with holes punched in the bottom provided rainfall.

Erosion, canyon formations, and alluvial deposits were demonstrated as Bill and Ronald Schlax played Jupiter Pluvius.

The remedy for the bad features of erosion was next demonstrated when Bill and Ronald repeated the experiment upon a piece of sod in the same position the exposed soil had occupied.

What would otherwise have been a series of reports and a display of charts and handwork was turned into an action-centered series of explanations accompanied by experiments. Pupils in my class enjoyed performing the experiments repeatedly and it soon became evident that the audience would like to do the same. As they left the auditorium they looked longingly at the homely equipment on the stage.

As the performers cleaned up their science equipment they chuckled about how much at home a boiling teakettle, flower pots, a makeshift hillside, and tin-can rainfall can be on the stage. Science can be dramatic and even taken into the auditorium to instruct and entertain.

Biology Teachers: Have You Tried Insects?

Many insect tissues are as representative as are those of mammals, and have the additional advantage of being unusually clear. Among the many we have prepared, we list the following:

1. Spermatogenesis,
2. Oogenesis,
3. Striated muscle,
4. Single neurons,
5. Fat body,
6. Digestive mucosa,
7. Salivary gland,
8. Malpighian tube, etc.

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Reproducible Plaster Casts
AS TEACHING AIDS

By ALFRED B. BUTLER

Assistant Professor of Physics and Education
The State College of Washington, Pullman, Washington

How would you like each biology student in your class to have a large model cell to study? Perhaps you would prefer a model of the cross section of human skin, or a cross section of a corn root tip, or a model of a glaciated valley, or the thermodynamic surfaces for water or carbon dioxide. Any of these, and many others, may now be inexpensively produced with the aid of a colloidal rubber paint available at many hobby stores, or through inquiry to one of many advertisers in *Popular Mechanics* or *Popular Science*. The rubber paint is used to make flexible molds from which any number of plaster-of-Paris casts can be made.

Most teachers have seen molding sets that use a red rubber mold. These are used to produce plaster models of animals, figurines, and a large variety of knickknacks. With the rubber paint it is possible to produce such a mold of any number of objects which would be useful in the classroom.

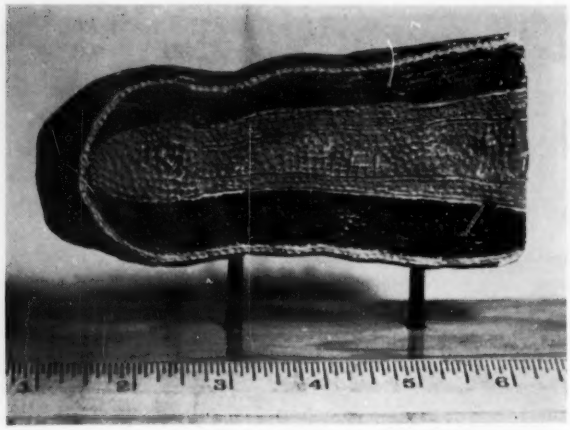
The usual procedure would be something like this. You, as a teacher, would like each student to have a model of the cross section of a living cell for study purposes. A pattern for the mold must first be made. This pattern may be made from wood or soap, but usually the ordinary variety of modeling clay is most convenient. Care taken in producing this original pattern will be repaid many times, for the rubber paint will reproduce faithfully all detail, including any careless fingerprints.

With the pattern complete, you are ready to put on the first coat of paint. Place the pattern on a piece of glass with the detailed side up. Prepare a small paint brush—one-inch size is satisfactory—by dipping it in motor oil or rubbing vaseline on it and removing any excess. This oil layer reduces the tendency for the paint to adhere to the brush fibers. Brush a light layer of rubber paint over the detailed surface, taking care not to "brush in" air bubbles. Be certain that all parts of the pattern are "wet" by the paint. The first coat may be thinned by adding a little distilled water to the paint in order to get better contact. The paint should be carried down the sides and outward on the glass surface for about an inch. This lip or rim around the mold will add strength and may be used as a support for the mold when castings are made later. The paint must be dry before a second coat can successfully be applied.

It is an excellent practice to rinse out the brush immediately, for the rubber begins to adhere within a minute or two. Careful washing in water will remove the wet paint and prevent the collection of rubber on the bristles. That which may collect can be rubbed out of the brush by pulling the bristles through your hand.

The second coat can be applied much thicker than the first coat, but care is still necessary to guard against air bubbles weakening the mold. Each coat may take from one to eight hours to dry. After the third coat has been applied, but while it is still wet and sticky, the paint should be sprayed with flock or dusted with fine sawdust. Flock is made up of very short lengths of rayon or cotton filaments which will adhere to a sticky surface, giving that surface a felt-like appearance. Phonograph turntables are usually coated with flock. This material and an inexpensive, though unnecessary, applicator are available at most paint stores or through Allied Radio Company, Chicago. The fine sawdust

This picture shows the steps in making a cell cross section—the clay pattern, the rubber mold, and the plaster cast.



Model cross-section of a root tip.

works very satisfactorily, however, and the author has used it rather than flock. This third coat strengthens the mold a great deal, but should be followed by a fourth coat, also flocked or sprinkled with sawdust, and a fifth coat to give it a final cover. Occasionally even more coats are desirable, and experience will be your guide. Usually the sides of the mold are weaker than you would expect. When this is the case, they allow the weight of the subsequent casting to bulge them out of shape. Extra attention to their thickness will result in much better molds and castings.

After the mold is complete, it can be removed from the glass plate and the clay pattern. It is best to dampen the rubber mold slightly in order that it will not tend to vulcanize itself together if two parts should happen to touch. The mold can be peeled from the pattern, turned inside out if convenient and washed with water.

Some large molds may need outside support during the casting process which follows. If this is so, the mold with the pattern inside should be set in a convenient sized cardboard box, open side up, and plaster of Paris poured around the outside of the mold. This secondary mold may well be separated into two parts by cardboard dividers in order to make removal of the mold easier. After this supporting cast has hardened, the mold can be removed and the casting started.

Plaster of Paris is mixed with water to the consistency of very thick soup and poured into the clean rubber mold (supported if necessary). This mixing and pouring of the plaster of Paris must be done without delay for it will start to harden quickly. Allow the casting to remain in the mold until quite hard. Removal may be made easier if the rubber mold is moistened and a few drops of water placed between the casting and the mold where it is first separated. Work the rubber mold from the casting and after it is washed clean in water, it is ready for storage or for reuse.

The plaster cast can now be painted with water colors, varnished or lacquered and mounted. Sometimes it is best to shellac the cast or give it an undercoat of white paint before coloring in order to seal the porous sections and make the color flow more evenly, in which case oil colors must be used. The casting may be drilled and mounted on metal rods set into a wooden base or wires may be set into the plaster at the back of the casting while it is hardening to form loops by which the cast may be supported.

Care in producing the original pattern is most important and is apt to be the most tedious portion of the job. Useful molds will accumulate, however, and in a few years an amazing variety of reproducible teaching aids will be available. Obviously more than one mold can be made from a pattern in order to expedite the subsequent casting operation.

Any scientific supply catalog will provide many ideas for possible castings. Many others will suggest themselves in addition to these, however. A model of a very young river valley and subsequent models of erosional phenomena may make general science or geography more interesting. The history of the formation of Yosemite National Park could be produced by each interested child. In physics or mathematics, any data which can be shown by a three-dimensional graph can be reproduced this way.

Such modeling is not limited to school-produced patterns, however. Fossils and other material may be safely reproduced, using exactly the same process. There is little danger of injury to the fossil if it is in relatively nonporous material, so the separation of the rubber mold will be clean. Schools could exchange plaster replicas of their best fossils.

A completed cast of a model of an enlarged cross section of human skin.

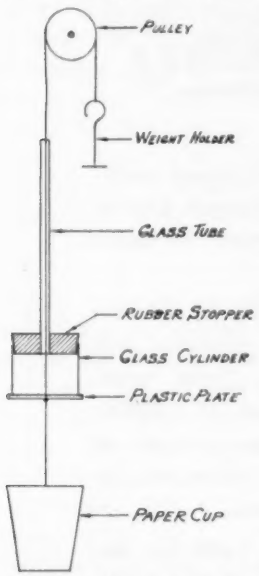
Classroom Ideas

Physics

Modified Pascal's Paradox Apparatus

By JOHN WALTERS, Browne and Nichols School
Cambridge, Massachusetts

With the simple apparatus pictured here it can be demonstrated that force on the bottom of a container is a function of area and depth, independent of the weight of liquid above.



A rubber stopper with a hole of about 16 mm. diameter bored through its center is inserted into a glass tube 3 to 4 cm. long and about 4 cm. in diameter. A piece of glass tubing 16 mm. in diameter and 30 cm. long is put through the stopper until flush with its lower side. This system is clamped to a ring stand.

A pulley is fastened above the long tube in such a position that a heavy thread will pass straight down from its circumference through the tube. This section of thread is passed through a 5 x 5 cm. plastic plate, and knotted above and below with a few inches to spare. A stiff paper cup, or any fairly light container of about 200 ml. capacity, is hung from the thread. A hook for weights is fastened to the other end of the thread hanging over the pulley.

In use, the hook is weighted enough so that the container when almost full of water will just overbalance it, causing the plate to drop away from the cylinder. The amount of water required is measured out of a graduate. Then, with the container empty, water is poured from the graduate down through the thin tube into the space above the plate. When a certain level is reached the plate will break loose; at that point the force on the plate is approximately the same as it was when the plate was pulled away by water in the container.

The difference in the two quantities of water can be very great, depending on the dimensions of the apparatus, which in our case was determined by tubing we had on hand. Conceivably, several setups could be constructed to show the effect of variation in surface area versus depth. It would of course be possible to make an apparatus requiring much greater quantities of water *above* the plate than in the cup.

Leakage between plate and cylinder and around the knotted thread can be minimized by the use of stopcock grease. The plate need not be plastic.

General Science

More *PHIZ* in the Physical Sciences

By J. EDGAR MORRIS, Brown Community High School, Atlanta, Georgia

Sometimes it is well to begin by defining words. Let us have no one get the idea that by *phiz* we mean letting the students' interest in the physical sciences, chemistry and physics, fizzle out. This is what we would like to prevent. I feel that one way to stimulate interest in these subjects is to utilize experiments and demonstrations that will arouse the students' curiosity. Most of us would agree that another way is to relate these subject areas of science to the students' everyday life experiences.

Here is a very simple experiment using readily available materials, that may be used for either of the following purposes: (a) to introduce the students to a study of CO_2 gas; (b) to demonstrate the principle of the foam-type fire extinguisher. We have here baking soda ($NaHCO_3$), Dreft washing powder, hydrochloric acid (vinegar could be used as a substitute), and an indicator, methyl orange. Note that even if this experiment is used early in a chemistry course the majority of the materials are already familiar to the students. I think it is a good idea to have some familiar materials and to introduce the students to at least one new material with each experiment or demonstration. We also have a large battery jar. If this is not readily available a one-gallon commercial size mayonnaise jar or other large glass container may be used.

I now fill the glass jar about one-fourth full of water, and to this I will add about four tablespoonfuls of baking soda and about twice this amount of

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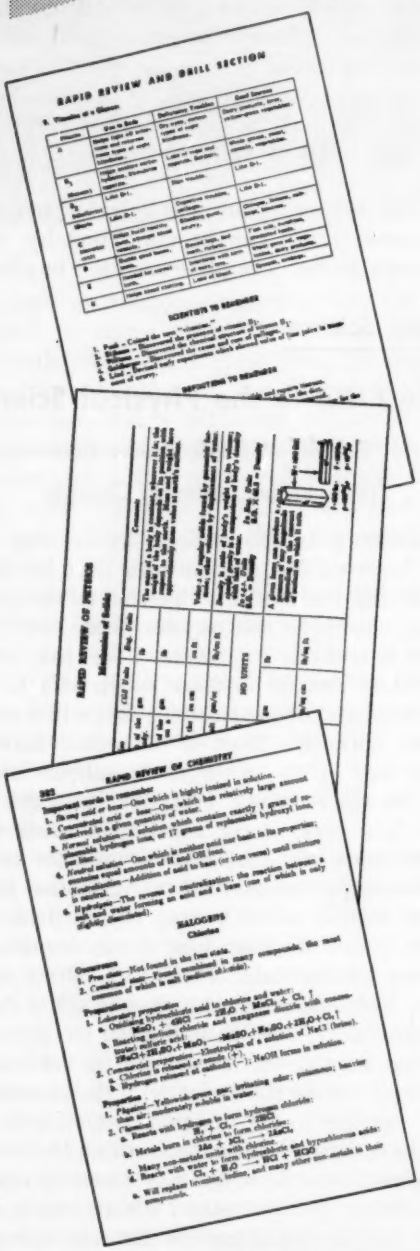

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Dreft. Note that a large container is used and enough materials so that the students in the back of the room do not have any difficulty in seeing exactly what is happening. To get colored bubbles and also show how an indicator works I will now add about 10 ml. of methyl orange solution and stir it until it is evenly distributed throughout the solution. Note the distinct orange color produced, showing that the solution is basic.

Before adding the acid to this mixture I will now ignite a mixture of used motor oil and gasoline in this pan. When it is burning the flame is readily visible throughout the room.

Now I shall add about 100 ml. of hydrochloric acid (1 to 4 concentration) and stir this into the mixture in the battery jar. Note that the color changes to pink, indicating that the solution is now acidic. Note also the copious volume of foam, which is fairly stiff and resembles a cherry soda (students sometimes ask if this is good to eat). Now to show how a foam-type fire extinguisher smothers a flame, I shall dip this foam out of the battery jar and place it on the burning oil. Notice how it spreads and puts the fire out. If a larger volume of foam had been produced, I could have tilted the jar and let the foam spill over into the burning oil. If a more stable type of foam is desired you may add some aluminum sulfate to the baking soda solution before adding the acid. Some commercial foam type fire extinguishers do use the aluminum sulfate.

How do you demonstrate that evaporation absorbs heat? Here is one simple way that never fails to attract attention. It clearly and vividly puts this idea across. I call this "cold fire." In an ordinary evaporating dish I place about 10 ml. of carbon tetrachloride (CCl_4) and about 6 ml. of carbon disulphide (CS_2). Both of these substances are volatile. The CS_2 burns readily, while the CCl_4 will not burn—in fact it is used as a fire extinguishing agent. I will now ignite this mixture. Note that it burns with a pale flame. While it is burning, I will dip my fingers down into the mixture and slowly lift them up so that you can see the fire burning on my fingers. No, it is not hot. In fact it even feels cool. The explanation is simple. The heat from the burning CS_2 is utilized in evaporating the CCl_4; therefore, if your proportions are right you actually have cold fire. Before you try this with your class, you should try it out first yourself. If the mixture does not burn, add a little more CS_2. If it feels warm when burning on your fingers, add a little more CCl_4.

Now I would like to say a few words about relating classroom activities to the students' everyday life experiences. Most general science classes and physics classes take up a unit of work on electricity sometime during the course. Too often the introduction to this topic is not presented in a manner that shows that it is in any way related to everyday life. This need not be the case. I am suggesting that as an introduction, a teacher might well have in his classroom as many of the following home appliances as he can obtain (usually an appliance dealer in the community will give or loan used items of this nature to the school): vacuum cleaner, refrigerator, mixer, electric coffee maker, hot plate, waffle iron, flat iron, etc. All of the students are already familiar with the most of these items. Introduce the unit by asking them how these work. Before you know it, they will be digging into Ohm's Law and all of the other laws and terms used in the unit. The difference will be that this time they will be doing it because they want to and not because it is an assignment.

Statistics show that the women of our country are constantly controlling an increasing proportion of our wealth. I suggest that they are also operating an increasing number of electrical and mechanical appliances in the home. Therefore if our physics courses are adapted to center largely around these appliances, I firmly believe that more girls will elect to take physics. Both boys and girls will get more out of the course if they are stimulated to learn about these things because of their practical uses.

From this presentation I hope you have observed that my theory is that we can put more "phiz" into the physical sciences by: (1) using experiments and demonstrations that will not only illustrate a point, but that will stimulate a student's curiosity, and (2) relating the subject matter to the students' everyday life experiences.

This paper was presented at a "Here's How I Do It" session of the NSTA Regional Conference held in Atlanta, Georgia, October 16-18.

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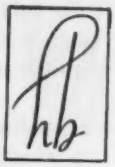

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SCIENTIFIC TALENT

(Continued from page 260)

of training greater numbers of white collar workers to do accurately the multitude of essentially routine operations and computations is becoming a difficult problem. Machines for the automatic processing and storing of business items offer a solution of great significance. We are most certainly on the threshhold of a business office revolution which will free the white collar worker from routine mental drudgery much as the industrial revolution of the last century freed the manual laborer from much physical drudgery. The carrying out of such a revolution will require, as with the preceding examples, still more scientists and engineers.

My discussion so far has been concerned almost entirely with matters in the physical sciences and in engineering because of my closer association with these areas of technology. I believe that similar examples could be cited in the fields of biology and medicine. It is, for example, well-known that such substances as anti-biotics have opened up and will continue to open up many new fields for exploration in these sciences. Also it is well-known that the tools from the physical sciences, electronic instruments in particular, have made possible a variety of new types of investigation in biology and in medicine.

Although all of the examples just presented have been covered very briefly, there is ample justification and support for the validity of each. I have attempted through a few examples to show that the trend of modern science and technology is an expanding one and one which could increase at an increasing rate the demand for trained workers. Whether the trend is fulfilled will depend more than anything else on the number of scientists and engineers available, and this in turn will depend on the number of students who elect to study science in our schools.

A large percentage of men and women select their careers while they are high school students. Certainly nearly everyone is influenced in one way or another in his selection of a career by his high school teachers. You have a very important role now in determining the number of people who will be starting their first independent researches five or ten years from now. As I indicated earlier the professional societies and industrial organizations are aware of the importance of your function. Therefore, I believe you can be assured of the full cooperation of the institutions needing scientists and engineers, in carrying out your responsibilities which will profoundly influence this country's strength and general prosperity in the years to come.

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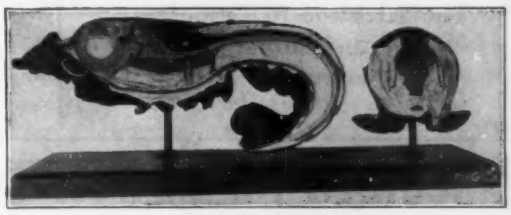

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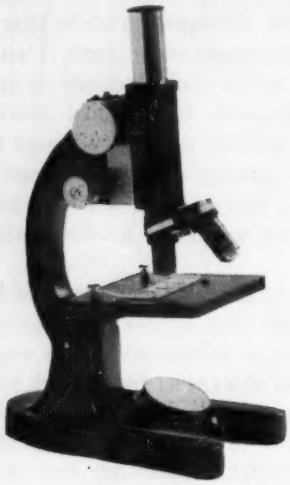

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CHEMISTRY PROBLEMS

(Continued from page 276)

separate unit of study without too much relationship to the remainder of the textbook organization.

In other instances, where it is introduced early in the study—say, the second or third unit—it is not too thoroughly integrated with the subsequent presentations.

Perhaps it would be feasible to introduce the idea of atomic structure immediately and build from that point. Each subsequent idea presented would of necessity be related to the original discussion.

Student Interest

Those who would object to the proposals given will revert to the idea that students would lose interest in this type of course. If the thought is conceived in the idea of the poorer student, the interest was never there under any type of presentation.

There is a misunderstanding prevalent in school circles between curiosity and interest. The first is a short-lived thing which varies always in intensity. Curiosity is stimulated by external things.

Interest, that which is genuine and real, comes from within. It accumulates over a period of time and may be in those things that do not lend themselves to spectacular displays and stunts. (The author does not depreciate the value of the lighter side of instruction as a method of developing interest but does contend that things of real educational value are not those items that are spectacular.) Interest comes from within, from familiarity, from mastery and understanding—the ultimate and legitimate goals of education.

From firsthand experience it has been learned that real class interest and stimulation comes from meeting the more difficult chemical concepts head on. And, in conjunction with the work in the laboratory, certain types of more fundamental exercises can acquire just as much interest as making shoe polish or soap.

True Test

The true test of the effectiveness of instruction as regards organization and presentation comes in the success of those who continue their study in the field of chemistry. The reports from the experiences in the first year of college work, regardless of the place where it is done, should be the base for evaluating the work the instructor has done.

What about the non-college group? There is no adequate check on the residual learnings for this group. There is likewise none with consumer chemistry. Consequently, it can be safely assumed that they too profit by the more disciplinary experiences.

Contemporary-Style

HEADQUARTERS FOR AAAS

WITH THE ENDORSEMENT of its Building Committee, the 48,000-member American Association for the Advancement of Science is moving ahead with plans for a modern, air-conditioned headquarters building in Washington, D. C., the architects' drawing of which is pictured on the front cover.

To be built on the present site occupied by the AAAS, the new structure will further enhance a neighborhood that is already a sort of center for educational and scientific organizations. Within the Scott Circle area are such groups as the American Chemical Society, the American Council of Learned Societies, the Geophysical Union, the National Education Association, the Carnegie Institution of Washington, the National Geographic Society, the American Nature Association, and others.

The gap between plans and a building ready for occupancy is a wide one, not so much in time as in the means of execution. Application for permission to build the proposed structure is now pending before the District Zoning Commission. Problems of financing are being studied and it is hoped that members and friends of the AAAS, whose generous response in 1946 made the purchase of the site possible, will again assist substantially in minimizing the financial burden.

Envisioned as a national science center, the new building, according to the architects, is "aimed at achieving a structure that expresses the pioneer spirit of science and the advancement and harmony that scientists seek." The main exterior material will be heat-absorbing glass. Machinery for complete air conditioning will be housed in a penthouse on the roof.

President of the AAAS is Detlev W. Bronk who is also president of the National Academy of Sciences and president of the Johns Hopkins University. President-elect is Edward U. Condon, formerly director of the National Bureau of Standards and now Director of Research for the Corning Glass Works. NSTA is one of the Association's 237 affiliated or associated groups.

NSTA Activities

St. Louis Program — A Star-Studded Bill of Fare

Close on the heels of the successful regional conference held in Atlanta October 16-18 (attended by three hundred science teachers) comes the annual joint meeting of the science teaching societies affiliated with the American Association for the Advancement of Science. To be held at the Hotel DeSoto in St. Louis December 27-30, this year's meeting provides an unusually rich and varied program. Following are the details of the joint sessions of NSTA, ANSS, and NABT and of the individual sessions of NSTA.

CONVENTION HEADQUARTERS

Parlor C, Hotel DeSoto

Saturday Morning, December 27

8:30 a. m. DeSoto Room, Hotel DeSoto; *Presentation of Science Teaching Films.* Arranged by James M. Sanders, Chicago Teachers College, for ANSS, NABT, and NSTA; similar showings at this hour on Monday and Tuesday.

10:00 a. m. DeSoto Room, Hotel DeSoto; *Implementation of Basic Principles of Good Teaching.* Joint session of ANSS, NABT, and NSTA; Roger Tory Peterson, *Presiding.*

1. Implementation of Basic Principles of Good Teaching. Francis D. Curtis, University of Michigan.
2. An Example From Elementary School Science. Glenn O. De Atley, Wood River, Illinois, Public Schools.
3. An Example From Junior High School Science. Ruth Armstrong, Fort Smith High School, Fort Smith, Arkansas.
4. An Example From Biology. S. M. Pattee, Roosevelt High School, Cedar Rapids, Iowa.
5. An Example From Chemistry. Richard W. Woline, Oak Park and River Forest High School, Oak Park, Illinois.
6. An Example From Physics. Martin Thames, Bemidji High School, Bemidji, Minnesota.

Saturday Afternoon, December 27

2:00 p. m. DeSoto Room, Hotel DeSoto; *Implementation of Objectives with Retarded and with Superior Students.* Joint session of ANSS, NABT, and NSTA; Harold E. Wise, *Presiding.*

1. At the Elementary School Level. Muriel Beuschlein, Chicago Teachers College, Chicago, Illinois.
2. In Junior High School Science. Mrs. D. B. R. Johnson, Norman Junior High School, Norman, Oklahoma.
3. At the Senior High School Level. Woodrow Pemberton, Benjamin Bosse High School, Evansville, Indiana.
4. In Junior High School Science. Violet Strahler, Wilbur Wright High School, Dayton, Ohio.
5. In Junior High School Science. S. Alton Yarian, Emerson Junior High School, Lakewood, Ohio.
6. At the Senior High School Level. Paul Klinge, Thomas Carr Howe High School, Indianapolis, Indiana.
7. General discussion based on forenoon and afternoon presentations.

Saturday Evening, Dec. 27

6:00 p. m. Cotillion Room, Hotel DeSoto; *Banquet of the Science Teaching Societies.* Arranged by local committee of St. Louis teachers.

9:30 p. m. DeSoto Room, Hotel DeSoto; *All-Societies Mixer.*

Monday Morning, Concurrent Sessions 1, 2, and 3 of NSTA, Dec. 29

10:00 a. m. Session 1; DeSoto Room, Hotel DeSoto; *Reports From Inside NSTA.* Arthur O. Baker, *Presiding.*

1. The History of NSTA and Its Contributions to Science Teaching. Nathan A. Neal, McGraw-Hill Publishing Company, New York City.
2. The Science Teacher. Morris Meister, Bronx High School of Science, New York City.
3. Packet Service for Science Teachers. Elbert C. Weaver, Phillips Academy, Andover, Massachusetts.
4. Future Scientists of America Program. Philip G. Johnson, U. S. Office of Education, Washington, D. C.
5. Current Committee Activities Related to Science Teaching. Zachariah Subarsky, Bronx High School of Science, New York City.
6. Advisory Council on Industry-Science Teaching Relations. John S. Richardson, Ohio State University, Columbus.
7. Business-Industry Section of NSTA. Louis M. Stark, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.
8. Outlook for the School Year 1952-53. Robert H. Carleton, National Science Teachers Association, Washington, D. C.

10:00 a. m. Session 2; Parlor D, Hotel DeSoto; *Business Meeting, Business-Industry Section of NSTA.* Louis M. Stark, *Presiding.*

9:00 a. m. Session 3; Ivory Room, Hotel DeSoto; *Symposium: Report of Research on the New York State Regents Science Examinations.* Joint session of AAAS Section Q, AAAS Cooperative Committee, and NSTA.

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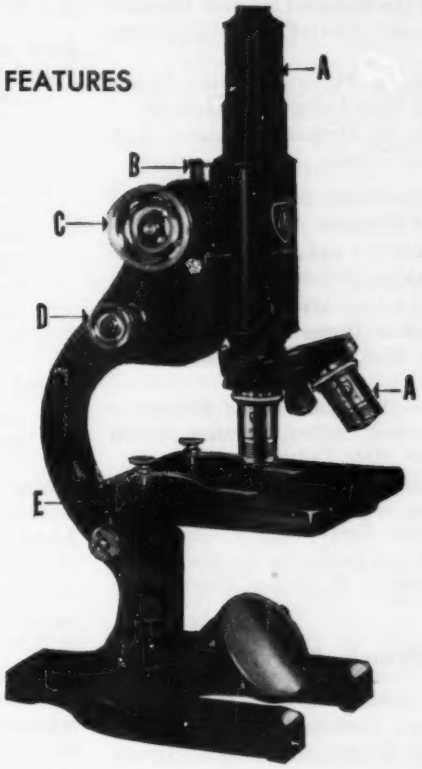

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Monday Noon, Dec. 29

12:00 noon Garden Room, Hotel Lennox; *Luncheon of Business-Industry Section of NSTA.* (All science teachers invited.) Address: The Importance of Science Education to Industry.

Monday Afternoon, Concurrent Sessions 1, 2, and 3 of NSTA, Dec. 29

2:00 p. m. Session 1; Parlor D, Hotel DeSoto; *Business-Industry Section of NSTA.*

2:00 p. m. Session 2; Ballroom Assembly South, Hotel Statler; *Improving the Program for Science in General Education at Senior High School and Junior College Levels.* James G. Harlow, *Presiding.*

1. General Education in the Biological Sciences. Charlotte L. Grant, Oak Park and River Forest High School, Oak Park, Illinois.
2. General Education in the Physical Sciences. Chester A. Lawson, Michigan State College, East Lansing.
3. General Education in the Methods of Science. J. J. Schwab, University of Chicago.

2:00 p. m. Session 3; Daniel Boone Room, Hotel Statler; *Improving the Program for Science in General Education at Elementary and Junior High School Levels.* Ralph K. Watkins, *Presiding.*

1. The Determination of Science Maturity as a Means of Improving the Program in Elementary Science. Clifford G. McCollum, Iowa State Teachers College, Cedar Falls.
2. Improving the Science Program for the Elementary School Through Improved Teacher Education. Robert Sherman, North Texas State College, Denton.
3. Improving the Science Program for the Junior High School by a Program of Reading in Science. Clyde Brown, Southern Illinois University, Carbondale.
4. The Use of Visual Aids in Improving the Junior High School Science Program. C. W. Ballew, University of Missouri, Columbia.

Tuesday Morning, Dec. 30

10:00 a. m. DeSoto Room, Hotel DeSoto; *Producing and Using Science Text and Reference Books.* Joint session of ANSS, NABT, and NSTA. Harvey Stork, *Presiding.*

1. What We Want and Need in Science Books. Panel: Arthur E. Jordan, Washington School, St. Louis, Missouri; Frederick B. Eiseman, Jr., John Burroughs School, Clayton, Missouri; William F. Goins, Jr., Tennessee A. and I. University, Nashville; William C. Van Deventer, Stephens College, Columbia, Missouri.
2. Problems of Publishing School Science Books Today. Panel: Arleigh Hough, Rand McNally & Company, Chicago, Illinois; MacLean Johnson, Webster Publishing Company, St. Louis, Missouri; Martin Robertson, the Macmillan Company, New York City; Richard T. Wareham, D. C. Heath Company, Boston, Massachusetts.
3. General discussion.

Tuesday Afternoon, Concurrent Sessions 1 and 2 of NSTA, Dec. 30

2:00 p. m. Session 1; DeSoto Room, Hotel DeSoto; *Here's How I Do It—Senior High School Sciences.* Charlotte L. Grant, *Presiding.*

1. The Teaching of Physics. Ralph W. Lefler, Purdue University, Lafayette, Indiana.
2. The Teaching of Chemistry. Elbert C. Weaver, Phillips Academy, Andover, Massachusetts.
3. The Teaching of Health Science. Richard H. Lape, Amherst Central High School, Snyder, New York.
4. The Teaching of Natural Sciences. Hubert M. Evans, Teachers College, Columbia University, New York City.
5. The Teaching of Conservation. F. Olin Capps, Missouri Conservation Commission, Jefferson City.

2:00 p. m. Session 2; Hunt Room, Hotel DeSoto; *Here's How I Do It—Junior High School and Elementary Science.* Dorothy V. Phipps, *Presiding.*

1. Using Resource Material in Elementary Science. Elizabeth Orahood, Public Schools, Kansas City, Missouri.
2. Clinching Elementary Concepts Through the Use of Industrial Arts Tools and Materials. Kenneth G. Gogel, Iowa State Teachers College, Cedar Falls.
3. The Use of Pupil Planning and Participation in Science Learning. Theodore B. Curtiss, Wydown School, Clayton, Missouri.
4. What Can We Teach About Atomic Energy? Mildred Einziz, Cleveland, Ohio, Public Schools.
5. Planning a Controlled Experiment in Science With Junior High School Pupils. Milton O. Pella, University of Wisconsin, Madison.

Space limitations preclude listing the many attractive sessions of the other cooperating societies and of the AAAS. However, brief mention may be made of some of these: the Junior Scientists Assembly, the AAAS Science Exposition, the AAAS Science Theater, the AAAS Presidential Address, and the annual field trip of ANSS and NABT. A fully detailed program of the meeting will be sent to all NSTA members early in December. Meanwhile, if you have not yet made hotel reservations for the meeting, please do so at once. Use the application form on page 246 of the October issue of *The Science Teacher.*

▶ *Instructional Exhibits* for St. Louis

Another display of demonstrations, apparatus, and teaching ideas devised by students and teachers will be held at the St. Louis meeting. YOU can help make it a success. Send or bring your home-made charts, models, and "gadgets" to be displayed for other teachers to see. Ship to yourself, c/o Mr. Charles Lakingen, 5204 Von Phul Street, St. Louis 7, Missouri. Teaching ideas and materials for all levels will be welcome. No idea is too simple or elementary to help someone else. The display will be held in the Hotel De Soto.

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1953 NOMINATING COMMITTEE BEGINS WORK

With the naming of the 1953 Nominating Committee by President Harold E. Wise, the three-month procedure for choosing a number of new NSTA officers and directors for 1953-54 gets under way. Second procedural step is this announcement inviting all members of the Association and all affiliated to send in to the committee names of persons whom they wish to recommend for consideration.

Positions to be filled in this election, and names of incumbents in parentheses, are as follows: President-Elect, (Charlotte L. Grant, who becomes president for 1953-54); Secretary (Zachariah Subarsky); Treasurer (Hugh E. Brown); Eastern Regional Vice-President (Richard H. Lape); Western Regional Vice-President (Miss Archie J. MacLean); Eastern Regional Director (Elra M. Palmer); Western Regional Director (W. Bayard Buckham); and two Directors at Large (James G. Harlow, Norman R. D. Jones, Della J. Patch, Stanley E. Williamson).

Please send suggestions to the chairman of the Nominating Committee, Miss Louise E. Lyons, Steubenville High School, Steubenville, Ohio. Other members of the committee are: Ira C. Davis, University of Wisconsin, Madison; Clyde T. Reed, University of Tampa, Tampa, Florida; Hubert M. Evans, Teachers College, Columbia University, New York City; Marjorie H. Campbell, Supervisor of Elementary Science, Washington, D. C. public schools; and W. Bayard Buckham, Oakland High School, Oakland, California.

These "coupon service" pages announce the availability of free and low-cost teaching aids for science. Those that are business-sponsored have been reviewed by the NSTA Evaluation Committee and approved for distribution by the Association. To procure copies of desired items, fill out the corresponding coupons and mail these, together with any remittance required, to the NSTA Executive Secretary, 1201 Sixteenth Street, N.W., Washington 6. Watch these columns for additional offerings in future issues of *The Science Teacher*. (Print or type coupons.)

THE A-B-C's OF ALUMINUM. *Reynolds Metals Company.* In simple non-technical language, this booklet tells the story of who discovered aluminum, what it is and what its properties are like, how it is made into useful products, etc. 32 pp.; free.

THE ZINC INDUSTRY. *American Zinc Institute.* A mine to market outline. Illustrated. Presents in concise form and in popular style the essential data about zinc and its products. Free.

THE STORY OF LEATHER. *The Ohio Leather Company.* Timely and interesting information in a well-written booklet. Instructional illustrations. Suited to use in seventh through twelfth grades. Specially suited to reference use and in special projects. Free.

THE WORK CARS DO. *Automobile Manufacturers Association.* An illustrated booklet which reports salient findings of a survey of the U. S. to determine how the American people use their cars and trucks. Especially useful in social sciences. Free.

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METHODS OF CONDUCTING A SCIENCE FAIR. *Cambosco Scientific Company.* Practical suggestions on financing, publicity, judging, etc.; lists 184 suggested exhibits. Developed by seminar group at Boston University. Free.

STUDIES IN CALENDAR REFORM. *The World Calendar Association.* One of the oldest scientific problems is that of the calendar. Difficulties of creating a satisfactory calendar first took primitive man into astronomy, says Professor Saha of the India Institute of Nuclear Physics (Calcutta) in the current issue of the quarterly Journal of Calendar Reform. More than 1,000 science teachers are members of The World Calendar Association. Yearly subscription is free to science teachers.

CORRELATIONS OF ELEMENTARY AND JUNIOR HIGH SCHOOL SCIENCE FILMSTRIPS. *The Jam Handy Organization.* A bulletin of page-by-page correlations for the use of the Jam Handy filmstrips with the science textbooks of thirteen publishers. Listings of filmstrips and textbooks would both be useful in selecting curriculum materials. Free.

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